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AUTHOR Potter, Paul Edwin
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ABSTRACT

Continental geology and tectonics are explored through this study of modern beach sands of South America. This report assesses how well petrographic studies of sandstones can recreate continental geography. Data on the petrography of 218 modern South American beach sands are presented and analyzed. The five major mineral associations of light minerals that exist along South America's coastline are explained in relation to both the petrographic data and to onshore geology. Study results support the premise that the five mineral associations that were specified by the proportion of rock types and average values are rich in interpretive significance and can provide a basis for further inference on the tectonics and geography of a continent. Appendices include sand location lists and complete petrographic data of beach and river sands. Descriptive figures and tables are also provided. A three-page list of references is included. (ML)

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SOUTH AMERICA AND A FEW GRAINS OF SAND

Part 1: BEACH SANDS

by

Paul Edwin Potter
H. N. Fisk Laboratory of Sedimentology
University of Cincinnati
Cincinnati, Ohio 45221

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ABSTRACT

South America has clearly defined active (Pacific coast) and passive margins (Atlantic coast), great contrasts in relief (Andes versus Llanos and Pampas), great contrasts of climate (Amazon rain forest versus Atacama desert), immense rivers, and is free of continental glaciation. Hence it is an ideal continent to study the petrography of modern sands and contribute to improved interpretation of ancient sandstones. This study reports on the petrography of 218 modern beach sands obtained from a shoreline of 25,300 km.

Judged by quartz-feldspar-rock fragment ratios, the beach sands of South America belong to five major associations: Pacific (24:16:60), Argentina (28:14:58), Brazil (91:4:5), Caribbean East (59:8:23) and Caribbean West (54:17:29). Study of potash feldspar, volcanic rock fragments, and the SiO_2/Al_2O_3 ratio supplement Q:F:Rf ratios. The dominant control on the mineralogy of these sands is tectonics and both the Pacific and Brazil associations, which form 75 percent of South America's coastline, identify correctly tectonic setting. However, the Argentine association would yield as serious error, because sand with active margin composition overprints a passive margin.

The roles of climate, relief and continental geography are discussed and emerge as important modifying factors that always deserve consideration when plate tectonics are inferred from the sandstones of ancient basins.

In broad perspective, the key question of all regional provenance studies is, "How well, and under what conditions, can petrologic study of sandstones recreate continental geography?"

INTRODUCTION

The idea that the petrographic study of 10 to 30 sandstone samples from an ancient basin, perhaps a sample of only 10^{-12} to 10^{-16} of its entire sandstone volume, can tell plate tectonic setting and thus infer major crustal processes borders the fantastic such that Sorby himself, the father of sedimentary petrology, might well be stunned at its audacity. Even more audacious is the question, "How well do the beach sands of an enitre continent reflect its continental geography and tectonics? Or, to put it differently, "What can one infer about a continent, if only the sands of its beaches are sampled and nothing is seen or known inland beyond them?"

This study explores this and related questions using the modern beaches of South America.

SAND, SANDSTONE, AND PLATE TECTONICS

Sandstone has been used as the key to help identify the tectonic setting of an ancient basin since the pioneering petrographic studies of Krynine (1942). Sand is the favorite for such study for many reasons. It is present in almost every basin, including some of the very oldest; better than any other sediment, each grain contains a record of provenance; and it occurs in almost every sedimentary environment with the possible exception of the abyssal plains of some deep sea basins.

Most theories of the petrographic and chemical composition of sandstone are based on its study in ancient basins - in contrast to studies of depositional systems, which are largely and securely based on the study of modern environments. This is particularly true of efforts to infer plate

tectonic settings from thin section studies of sandstones, which are largely based on the study of Mesozoic and Tertiary basins. Much of the work on ancient sandstones has been effectively carried out by Dickinson and his coworkers (Dickinson, 1970; Ingersoll and Suczek, 1979; Dickinson, 1982; Dickinson and others, 1983). More than forty papers on the plate tectonic interpretation of sandstone mineralogy such as that of Schwab (1975) have appeared since 1970 and virtually all recognize three different major tectonic settings with seven to nine subdivisions using standard compositional triangles (Fig. 1).

Such studies have been supplemented by studies of modern sands of the deep ocean and alluvial sands (Potter, 1978; Franzinelli and Potter, 1982; Harrold and Moore, 1975; Stewart, 1976; Valloni and Maynard, 1981; Maynard and others, 1982; Scheiddegger and Krissek, 1982; Yerino and Maynard, 1984), the tectonic significance of framework mineralogy being their main concern. Ease of sample collection from deep sea and shelf facilitates the study of modern marine sands, some of which are far removed from the continents from which they were ultimately derived.

Study of modern sands, to be most effective, should include only the sands of one environment in an area sufficiently large to have great contrasts in tectonics, relief and climate. Finally, the modern sand of a continent, the home of the vast majority of sand and sandstone so to speak, is far better to study than modern sand in the ocean where neither subaerial relief nor continental climate are easy to evaluate.

Climate, relief and modification by transport are at best but poorly known in most ancient sandy basins so that evaluation of their relative importance as modifiers of framework composition, is uncertain. Add the

effects of diagenesis - the conversion of some rock fragments to secondary clay-like matrix, glass to zeolites and calcic plagioclase to albite - and it is clear that source rock composition is but one of several factors that control the mineralogy of ancient sandstones (Fig. 2). Nonetheless, such factors are largely ignored and most investigators "let the results speak for themselves", which in many studies they have done effectively - plate tectonic control on mineralogy seems overwhelming. Yet is it really safe to ignore these factors? See Mack (1984) for discussion of possible limitations and problems, Mack (1978) for an evaluation of transport modification on framework grains, Suttner and others (1981) and Potter and Franzinelli (1984) for the role of climate. The study of modern sands both on and offshore to establish a petrographic baseline for plate tectonics also contains important assumptions (Fig. 3). Deep sea sands, for example, may be far removed from a continental source, some may have traveled long, complex paths on moving plates, and some may be more than several hundred thousand years old and thus not exactly "modern". As a rule, they are also finer grained than the typical sand of the continent. Nor are modern on shore sands perfect for study largely because Pleistocene climatic variations - even in the tropics - probably were appreciable so that, to some degree, modern sand from a nonglaciated continent may not totally be the product of present climate. Thus estimating the relative importance of source rocks, relief, climate, and transportation on the framework mineralogy of modern sands appears to be far more difficult than the successful comparison of modern and ancient depositioanl systems - the foundation of today's facies analysis. Offset in time between today's climate and that which produced the sand we call "modern" is the key problem. Whether ancient sandstones or modern sands are studied, comparisons based

on samples from the same environment always offer the greatest reward.

WHY THE BEACHES OF SOUTH AMERICA?

Why study modern beaches? The beach is the interface between marine and non-marine environments so that all marine sands have passed through it and, with recycling, perhaps the same is true for many, if not most, ancient sandstones. Because the beach environment is one of high kinetic energy, it provides a strong test of another factor - modification of framework mineralogy by abrasion. In other words, if petrologists can correctly identify the tectonic setting of a landmass from its beaches, and infer something of its geography as well, surely they could do so from its fluvial sands. Finally, the beach is an easy environment to reach and sample - an important factor when an entire continent with a coastline of 25,300 km is to be sampled. Field work soon shows that beach sand has multiple sources so it provides a very good estimate of average coastal sand composition (Fig. 4).

A pioneer study, one that provided the model for my efforts to sample the beach sand of an entire continent, is that of Du Rietz (1953), who showed how the petrology and chemistry of modern Baltic beaches became more mature as littoral drift transports sand away from the southern edge of the Baltic Shield. Also providing a model is the chemical and petrographic study of over 200 samples of Gulf Coast beach sands from Alabama into Texas by Hsu (1960).

South America, fourth in continental size and forming 12 percent of the earth's land surface, is the most elegantly asymmetric of all the continents from a plate tectonic standpoint - "half" active and "half" passive (Fig. 5). All its west coast is a leading edge and all of its

eastern coast from Tierra del Fuego to Trinidad is a trailing edge and only its Caribbean border is less clearly understood, although translation seems to be important. It is also largely free of continental glaciation, which complicates attempts to relate provenance of modern sand to climate by seriously blurring the continental distribution pattern. The climate of South America ranges from arid, with extremely dry deserts, through temperate to tropical, with up to 10 m of rainfall in northwestern Colombia (Fig. 6). Physiographic contrasts are equally impressive. The Andes Mountains are the world's longest mountain range with a length of almost 9500 km, have towering peaks, an average elevation only second to that of the Himalayas and many high, vast, dry plateaus. Additionally, South America has sweeping plains and low plateaus - some dry and grass covered, some covered by vast jungles. Also present along much of the Brazilian coast are forest covered mountains, mountains such as the Serra do Mar composed of Precambrian rocks that rise from a narrow coastal plain. Good summary of coastal physiography and climate for the entire continent is provided by Encyclopaedia Britannica (1974, v. 17, p. 73-104) and Psuty and Mizobe (1982). See Appendix I for a summary of relevant literature and Rich (1942), a Cincinnati professor, for an early areal overview.

Another reason to study South America is that there is now some data on the petrography and chemistry of the modern river sands of the Amazon and Tocantins basins (Franzinelli and Potter, 1982), an area that covers about 40 percent of all of South America. Some petrographic data also exists for the Magdalena, Orinococ, Parniba do Sul, Paraná and Sao Francisco rivers (Potter, 1978), as well as for small rivers on the Peruvian coast (Scheiddegger and Krissek, 1982). Together these river sands come from basins that drain about 65 percent of the continent. Scheiddegger and Krissek (1982) studied the quartz-feldspar ratio in 0.62-0.25 mm fraction of 41 Peruvian river sands. There are also a few petrographic studies of South America's beach and shelf sands (Table 1).

Thus there are on hand samples of an entire continent, a continent with great contrasts in source rocks, relief, and climate and one free of continental glaciation, although like all the world, it is not totally free of Pleistocene-induced climate changes (Fairbridge, 1970; Van der Hammen, 1974; Damuth and Baker, 1983; Parrish and Curtis, 1982; Tricart, 1975).

SAMPLING AND STUDY

Over two hundred samples were collected around the South American coastline in 116 days of field work (Fig. 7) and organizations and individuals in every coastal country contributed (please see Appendix I). Sampling was largely determined by accessibility and sample points range from 50 to as much as several hundred kilometers or more, although samples were sought about every 100 to 200 km. Sand from the berm was collected. Where possible, fine- to medium-sand was collected to best match the dominant size classes with midpoints of 170 and 350 mm (1.5 and 2.5 ϕ) reported by Shea based on his compilation of 11,212 analyses, chiefly of onshore sands and sandstones, but including some sands from modern continental shelves. These two size classes include about 35 percent of his average grain size distribution. Because the grain size of my samples is coarser than that of most deep sea sands, more rock fragments with their greater provenance information can be expected than in studies of typical fine grained, deep sea sand derived from the same source. To avoid the pitfalls of studying only a narrow size fraction and missing important diagnostic grains (Van Andel, 1950), the entire sand was impregnated and studied using standard counting procedures after staining for potash feldspar. The method of Zuffa (1979) was not used because some of the counts date from 1976 and I wished to be consistent with my earlier studies of South American modern sands. I also

wanted to use the standard methods to demonstrate their effectiveness and resolving power.

At twenty-seven localities pairs of samples 0.5 to 3 km apart were collected (Fig. 7) to obtain an estimate of the variability of total quartz (Q), total feldspar (F) and total rock fragments (Rf) within a beach. Differences between paired samples were calculated for each component, ΔQ, ΔF, and ΔRf, and 90 percent confidence limits were calcualted using 26 degrees of freedom (Table 1). These calculations indicate that in repeated random sampling 90 percent of the time the difference in total quartz content between paired beach samples will range between 8.4 to 4.3 percent, between 6.3 to 2.2 percent for total feldspar and between 7.2 to 4.8 percent for total rock fragments. These differences are small in comparison to regional differences around South America, which are far greater.

The above petrographic analysis are supplemented by a few complete chemical analyses and by analyses of SiO_2 and Al_2O_3 for 56 beach sands which effectively reenforce petrographic conclusions. As the report was prepared, an error was unfortunately discovered in the analyses for K_2O and Na_2O. See Appendix II for a printout of the basic data.

RESULTS

Five major mineral associations of light minerals (Table 2 and Fig. 8) exist along South America's coastline and go far to answer the question, "How well do the beach sands of a continent reflect its geology?"

The Pacific association extends all along the west coast of South America in Colombia, Ecuador, Peru and Chile; the Argentina association extends from Tierra del Fuego all along Argentina's Atlantic coast to the Rio de la Plata (Fig. 7); the Brazil association reaches from the Rio de

la Plata and includes the coastlines of Uruguay, Brazil, French Guyana, Suriname, Guyana and part of Venezuela to southern Trinadad; the Caribbean East association occupies all the north coast of Venezuela and that part of Colombia east of Rio Magdalena; and the Caribbean West association is the smallest and extends from the Tio Magdalena to Panama.

The limits of the five associations were defined by inspection of the petrographic data and by relating them to onshore geology, especially the location of major river mouths. Some information on river mineralogy is available (Potter, 1978; Franzinelli and Potter, 1983) plus scattered literature references (Appendix II) and supplemented by knowledge of rock types, distribution of active volcanoes and longshore drift. These criteria were used to outline the limits of the four associations initially defined by but 27 samples (Potter, 1984). It was necessary to have two Caribbean associations rather than but one.

For each association average proportions of petrographic types were calculated as well as average values and standard deviation of selected petrographic variables (Table 2 A and D and Figs. 8, 9, 10 and 11). The standard deviations are large for many of the average values and reflect high local petrographic variation - not surprising considering the greath length of some of the associations. Some of the five associations may contain subassociations based either on additional careful study of quartz types, feldspar compositions determined by microprobe (Travenia and Nash, 1981; Yerino and Maynard, 1984; Maynard, 1984) or rock fragments. Future study of heavy minerals is still another possibility and, as more variables are studied, more potentially differing limits or subassociations are likely. The Pacific association seems especially likely to contain lesser subassocations. Nonetheless, from a continental perspective, the present five associations specified by proportions of rock types and average values are rich in interpretive significance and go far to answer the question, "What can one infer about a continent, if only

its beach sands can be studied and nothing is seen or known inland beyond them?"

Pacific Association: This active margin association, extending from Panama to Tierra del Fuego is based on 74 samples. The Pacific association is dominated by rock fragments so that its average Q:F:Rf ratio is 24:16:60 (Fig. 8), an average that is broadly similar to 16:26:58 reported by Yerino and Maynard (1984, Table 1) based on 46 samples. Some extreme values of Q:F:Rf range from 0:2:98 through 16:5:79 to one sample with a Q:F:Rf value of 78:6:16. Together sublithic and lithic arenites form 91 percent of its rock types, subarkosic and arkosic arenites only 9 percent and there are no quartz arenites (Figs. 9 and 10). Monocrystalline quartz forms about 80 percent of all quartz and the F_k/F_t ratio is the lowest of all in South America, 0.209. Volcanic rock fragments predominate and average 56 percent (Yerino and Maynard, 1984, Table 1, report 82%). The SiO_2/Al_2O_3 ratio for this province has median value of 4.63 (Fig. 11), which fits an active margin, but is lower than the typical value of 16.78 reported by Potter (1978, Table 9) for 8 active margin rivers. Thus the Pacific association is overwhelmingly mineralogically immature all along its great length. The average of our complete analyses (Table 3) is broadly similar to those published by Bhatia (1983, Table 3 for active continental margins.

Argentine Association: The petrographic composition of beach sands along all the Argentina coast is similar to that of South America's Pacific coast - a somewhat surprising result. The average Q:F:Rf ratio is 28:14:58 and all 22 samples are lithic arenites, the only association to have but one petrographic type (Fig. 9 and 10). Yerino and Maynard (1984, Table 1) report broadly similar values in some offshore sands in southern Argentina and Teruggi (1964, Table 8) early showed the immature petrographic composition of beach sands in northern Patagonia as has Andreis (1965, Table 9) for a Pliocene deposit. The ratio of monocrystalline quartz to total quartz,

Q_m/Q_t, averages 0.746 and the F_p/F_t ratio is 0.328, somewhat higher than that of Pacific coast beach sands. Volcanic rock fragments average 71 percent. The chemical parameter closely reflects the petrographic ones: the median value of the SiO_2/Al_2O_3 ratio is 4.15. Hence Argentine beach sands have a closely identical composition to those of the Pacific association and the average of two complete analyses (Table 3) are similar to those of the Pacific association and to those of Bhatia (1983, Table 7) for active continental margins.

Brazil Association: Of all the five associations, the Brazil association, with 87 samples, which extends from the Rio de la Plata to Trinidad, a distance of over 7000 km, is the most mature with a Q:F:Rf ratio of 91:4:5 and, in terms of petrographic types, 63 percent of its beach sands are quartz arenites, 14 percent are subarkoses or arkoses and 23 percent are sublithic or lithic arenites (Figs. 9 and 10). Individual analyses show wide variations from 100:0:0 to four that have 20 percent or less quartz. But because most of the sands of this association are mature, the Q_m/Q_t ratio is the highest of all of South American beaches, 0.953. Two petrographic studies of beach sands show the local wide variation of feldspar possible in this association; Bittencourt (1975) reports a maximum of 3.5 percent for beach sands in Salvador and that only in beaches with exposed crystalline rocks whereas the Rio Doce delta, studied by Coutinno (1974), has feldspar values up to 19 percent.

The F_k/F_t ratio is also the highest, 0.709, reflecting both the granites and gneisses of the Brazilian and Guyanan Shields and the greater stability of potash feldspar over plagioclase feldspar in weathering, especially the tropical weathering that prevails over much of the continent bordered by this association. Volcanic rock fragments, R_f, are virtually absent except possibly for a very few derived from the Cretaceous basalts of southwestern Brazil. Thus the Brazil association is, with a few exceptions, typical of that of a passive margin in spite of the fact that the Serra do Mar provides

high relief and granites and gneisses along parts of the Brazilian shoreline south of the Sao Francisco delta. The median value of the SiO_2/Al_2O_3 ratio is 96.52 and thus is typical of a passive margin. Potter (1978, Table 9) reported an average SiO_2/Al_2O_3 value of 51.78 for 20 trailing margin rivers. The average of five chemical analyses have 90.09 percent SiO_2 (Table 3), are similar to the average of 26 analyses of quartz arenite published by Pettijohn (1963, Table 12) and fit fairly well average compositions for passive margins published by Bhatia (1983, Table 8). The fraction analyses of Figure 12 show in striking manner the contrast between the rock fragment-rich beach sands of Peru on South America's active margin and the quartz-rich beach sands at Natal on its passive margin. Can anyone doubt the difference?

Caribbean East Association: The association from Trinadad to the mouth of the Magdalena River in Colombia is based on 37 samples, whose average Q:F:Rf composition is 69:8:23 and whose petrographic types vary widely reflecting great diversity of coastal geology, moderate to high relief and low rainfall; 19 percent of the samples are quartz arenites, 22 percent are either subarkosic or arkosic arenties and 59 percent are sublithic or lithic arenites. The Q_m/Q_t ratio averages 0.800 and the F_p/F_t ratio is 0.523, intermediate between that of the active margin, 0.209 and the passive margin, 0.709. The median value of the SiO_2/Al_2O_3 ratio is 36.8 also intermediate. Most of the coastal rocks along this part of South America are of Tertiary or Mesozoic age and the eastern part of this province is dominated by the Cordillera de la Coasta and the Cordillera de la Oriente in Venezuela, both consisting of metasedimentary rocks of low to intermediate grade. Tectonics along the Caribbean coast of Venezuela are not fully understood, although translation seems to be predominant (Schubert, 1981; Bonini and others, 1984).

Caribbean West Association: The mineral association from the mouth of the Magdalena River to Panama cover the shortest distance by far, is based on but

expected to change as the dynamics of the subduction process changes along South America's west coast.

2. Conversely, from the Argentine association the incorrect conclusion of an active margin would be made, when in fact all the Argentine coast is a trailing margin even though it plots in the transitional arc and recycled lithic fields (Figs. 12 and 13). Both the narrowness of Patagonia (Fig. 1) and its dry climate (Fig. 6), which inhibits weathering and alteration of debris in transit to the coast, cause this overprint. To this should be added the idea that most of Patagonia's beaches are gravel rich and most of their rare sands are derived from the Tertiary Patagonia Formation or from the Quaternary Rodados Patagonicos. The few misfit streams draining from the Andes across Patagonia contribute negligible amounts of sand at present.

3. The Brazil association identifies a passive margin beyond doubt but contains some surprises.

   (a) Mature quartz arenites predominate but some subarkosic sublithic arenites occur along the coast and present sample density is insufficient to explain local high feldspar occurrences. Coutinho (1974, Table 2), for example, shows high feldspar in the sands of 125-250 fraction of the Rio Doce delta (Fig. 8). However, surprisingly pure quartz sand close to the gneissic mountains of the Serra do Mar suggests that Brazil's high energy coast can eliminate feldspar quickly - certainly an idea that needs testing at selected localities along the Brazilian and other high energy costs bordered

by gneissic or granitic mountains, especially in tropical climates, where incipient weathering along the cleavage of feldspar may significantly enhance mechanical weakness.

(b) The coastal Serra do Mar of southern and southeastern Brazil with its Precambrian gneisses has, in spite of coastal relief of 300 to 600 m, comparatively little effect on composition of beach sand so that its extent and relief would almost certainly not be inferred correctly from the beach sands of this part of South America's passive continental margin. A somewhat similar paleophysiographic setting seems to be provided by the Cambrian Lamotte Sandstone bordering the Precambrian St. Francis Mountains in the Ozarks of Missouri, where arkoses and subarkoses pass rapidly into quartz arenites (Houseknecht and Ethridge, 1978).

(c) The Brazil association of beach sands is supplied by three large rivers - the Amazon, Orinoco and San Francisco - and is bounded on its southern limit by the Rio de la Plate. In addition, it includes other smaller but significant rivers (Fig. 8) such as the Paraiba do Sul and Rio Doce in southeastern Brazil, the Paraniba and the Rio Gurupi in northeastern Brazil and the Esquibo and others in the Guyanas. There is some scattered data on the composition of the sands of these rivers (Table 4).

The most interesting conclusion of Table 4 is the absence of lithic arenites contributed by the larger rivers

whose tributaries drain the Andes or even the Sao Francisco craton (Fig. 15). See Franzinelli and Potter (1983), Potter (1984) for discussion of how weathering as well as possible dilution masks the upstream, active margin provenance of large rivers draining across a tropical to subtropical craton toward a passive margin. Although data is scant, even the smaller rivers of the Brazil association seem to show a similar downstream increase in mineralogical maturity.

(4) The beach sands of the Caribbean East association are the most diverse petrographically and range from a few quartz arenites to arkoses to lithic arenites and thus its sands imply no great tectonic end member - neither passive, quartz-rich margin nor active, volcanic-rich margin. Their average composition plots as a recycled orogen as does the Brazil association but is far less mature, 59:8:23 versus 91:4:5, and its predominant rock fragments are metamorphics, which nicely reflect the proximity of the Cordillera de la Coasta and Cordillera de Oriente in Venezuela. Petrographic evidence for strong regional translation along the north coast of South America seems absent, however.

(5) The beach sands of the Caribbean West association are lithic arenites, and also plot in the recycled field and their minor volcanic debris contributed by the Magdalena River would suggest access to a magmatic arc as is true. However, one would have no way of knowing from petrology alone that this arc strikes approximately at right angles to the trend of the coastline; i.e., that the Magdalena flows along the strike

of the Andes and empties into a small marginal sea rather than into a large ocean bordered by a subduction zone.

MAJOR CONCLUSIONS

Inferences we know to be correct about the tectonics and geology of the hinterland of South America from the petrographic study of its bordering beach sands are impressive beyond doubt, but also include some incorrect and uncertain ones.

The Pacific and Brazilian associations, which together form about 74 percent of South America's coastline, correctly identify its active and passive margins without doubt.

Inference from the Argentine association would, however, lead to totally incorrect conclusions, because active margin composition mantles a passive margin. The dry climate of Patagonia probably enhances this effect as does its narrow width. It is intriguing to speculate upon the combination of aridity and width needed to minimize such mantling.

The two Caribbean associations imply an immature source area, free of volcanics except for the Carribean West association, with composition intermediate between that of South America's active and passive margins. However, identification of major translation seems unlikely from petrography.

The tectonic classification scheme of Dickinson and others (1983, Fig. 1; Fig. 1 this report) seems to work well and thus pass its "South American test".

Climate plays a role but remains difficult to evaluate quantitatively. In all probability, an arid climate along Brazil's coastline would produce far more feldspar and rock fragments in its beach sands than reported here and a wet climate along the Argentine coast would produce less. On the

other hand, relief is so high along the Andes that a wet climate might simply enhance volume of debris rather than alter its composition. It also seems clear that an arid climate over all the Brazilian and Guyanan Shields would significantly alter the composition of the Amazon, Orinoco and Paraná Rivers such that they could carry active margin composition across the continent to its far distant passive margin.

Petrography alone tells woefully little about the relief of South America and would be misleading about distance of a source from the coastline. This conclusion - not unsurprising perhaps to the experienced petrologist - seems well worth remembering, however, when studying ancient sandstones.

Far fewer samples could have been used judging by the reasonably good agreement between inferences based on 27 samples (Potter, 1984) and the more than 200 of this study in so far as mapping and identifying mineral associations - five rather than four. On the other hand, the more than 200 of this study provide far better estimates of the average composition of each association and, along the Pacific coast, sampling may be dense enough to identify subassociations in future studies.

The ratio SiO_2/Al_2O_3 is rather effective at discriminating tectonic setting, but is subject to the same limitations as petrography - except that it might be quicker and cheaper.

More detailed study of rock fragments, the K_2O/Na_2O ratio, feldspar types determined by microprobe and heavy minerals will be most informative from many points of view:

(a) mapping the influence of South America's three active volcanic zones, and

(b) subdividing the present five associations.

Nonetheless, the five associations recognized here provide a good positive assessment and show that "one can infer much about a continent such as South America, if only its beach sands are studied and nothing seen or known beyond them." Future studies should include, however, continents with more complex geographic configuration and tectonics. Finally, should we not consider the possibility of deducing the continental distribution of its modern sands given knowledge of its continental geomorphology, climate, and tectonics? In short, how soon will sandstone petrology be ready to model sand distribution across a continent rather than simply map it?

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Figure Captions for

SOUTH AMERICA AND A FEW GRAINS OF SAND
PART I BEACH SAND

1. Triangles developed by Dickinson and his coworkers for the plate tectonic interpretation of sandstones are largely based on studies of ancient sandstones.

2. Flow diagram for reconstruction of relief, source rocks and climate of the source area of an ancient sandstone. Solid black triangle represents what actually existed and stippled triangle represents what we infer after debris passed through the modifying filters of transport, burial and man-made methods of observation.

3. Major limitations affecting the tectonic interpretation of both modern and ancient sandstones. In ancient sandstones relief, transport, and paleoclimate are difficult to determine and burial diagenesis alters feldspar and rock fragments.

4. Sources of beach sand. Solid lines represent major paths and broken lines minor paths. Beaches of South America illustrate all four possibilities.

5. Key tectonic features of South America relevant to baseline study of its modern beach sands.

6. Rainfall in cnetimeters.

7. Beaches sampled and watersheds of South America's major rivers. Black circles indicate duplicate samples from the same beach. See Table 1.

8. Mineral associations of modern beach sand of South America and average proportion of quartz (Q), feldspar (F) and rock fragments (Rf).

9. Mineral associations and petrographic types. Numbers represent samples in each field. Compare with figure 10.

10. Bar graphs of sandstones in each mineral association: AA, arkosic arenite; SA, subarkose; LA, lithic arenite; SLA, sublithic arenite; and QA, quartz arenite.

11. Stepwise cumulative curves of the Al_2O_3/SiO_2 ratio for the five associations of modern South American beach sands.

Figure Captions - Continued

12. Contrasting petrology of fraction analyses of passive margin beach snad at Natal, Brazil and of active margin sand at Huacho, Peru.

13. Provenance types of different mineral associations of South American beach sand following Dickinson and others (1983, Fig. 1). Numbers are samples in each subfield.

14. Provenance types of mineral associations of South America's beach sands following Dickinson and others (1983, Fig. 1). Numbers are samples in each subfield.

15. Changing proportions of quartz (stippled), feldspar (black) and rock fragments (hatchured) from Andean source to Atlantic mouth for the Orinoco and Amazon-Solimoes Rivers. Would such changes occur in semiaried, temperate or subarctic rivers?

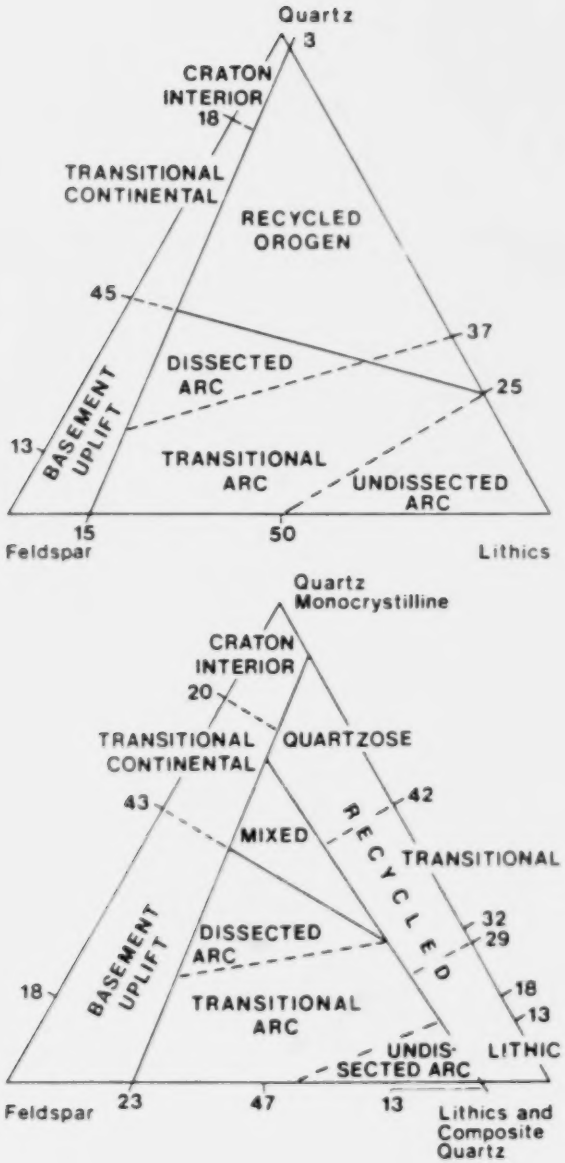

Fig. 1. Triangles developed by Dickinson and his students and coworkers (1983) for the plate tectonic interpretation of sandstones are largely based on studies of ancient sandstones.

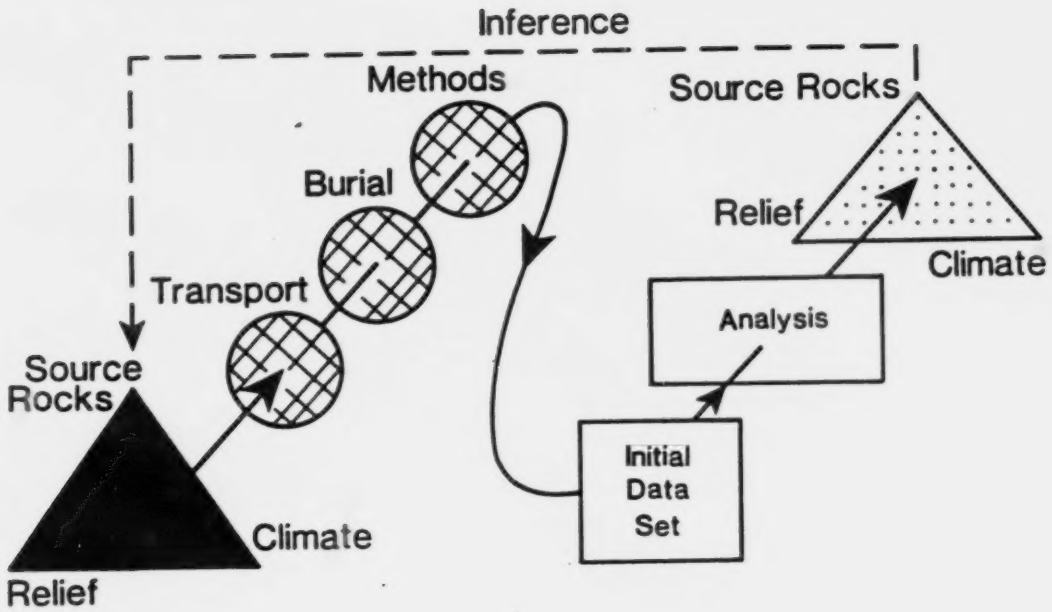

Fig. 2. Flow diagram for reconstruction of relief, source rocks and climate of the source area of an ancient sandstone. Solid black triangle represents what actually existed and stippled triangle represents what we infer after debris passed through the modifying filters of transport, burial and man-made methods of observation.

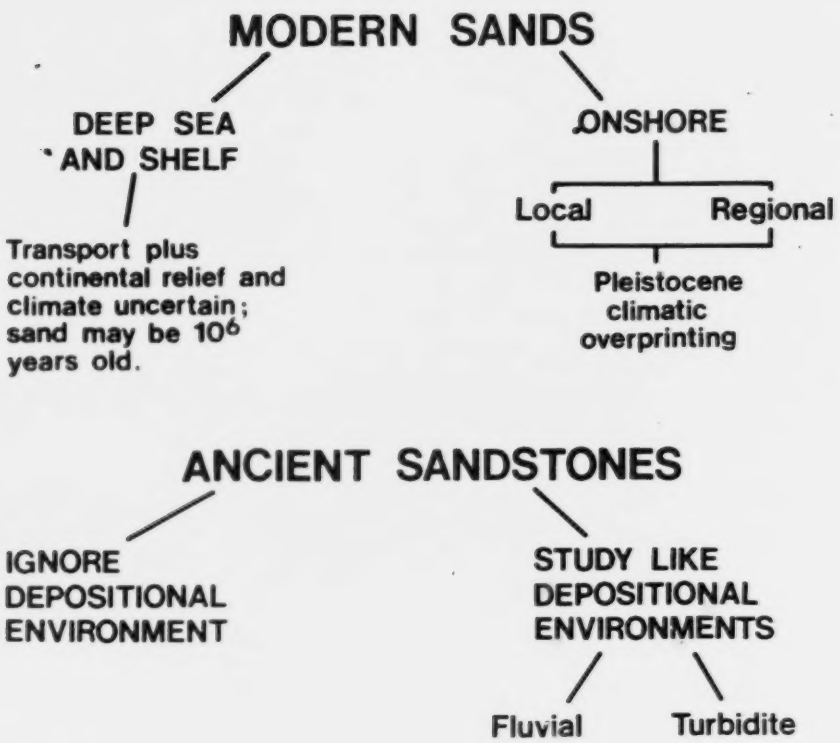

Fig. 3. Major limitations affecting tectonic interpretation of both modern sands and ancient sandstones. Relief, transport and paleoclimate are difficult to delineate and burial diagenesis alters feldspar and rock fragments.

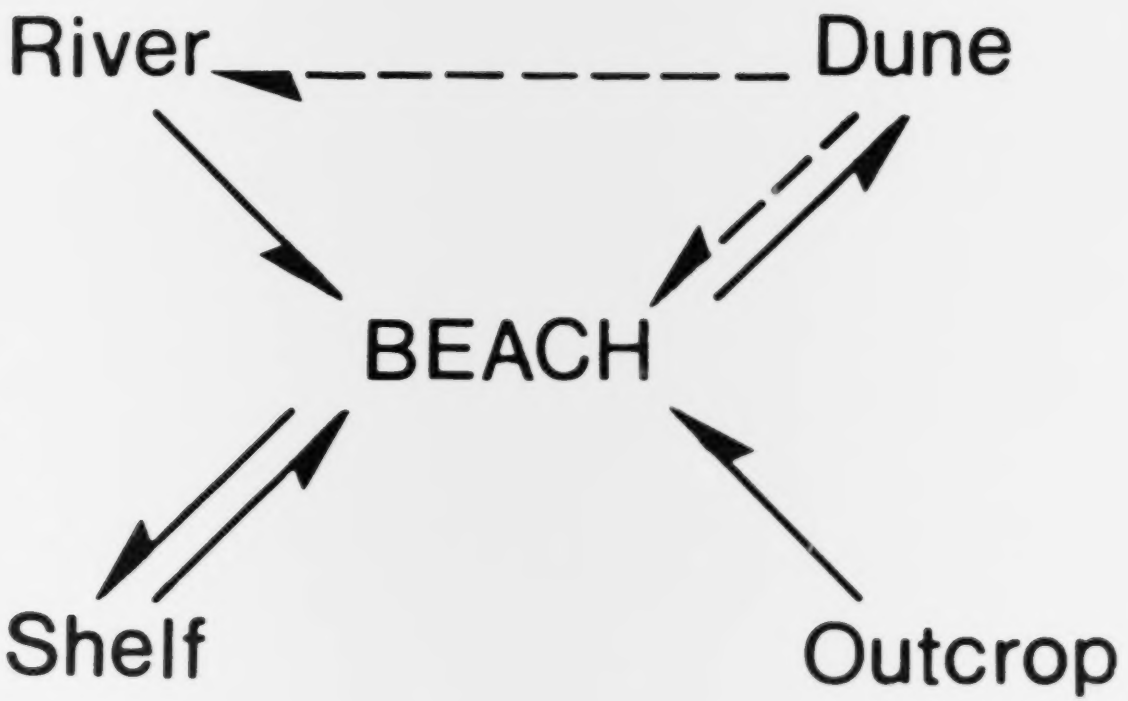

Fig. 4. Sources of beach sand. Solid lines represent major paths; broken lines minor paths.

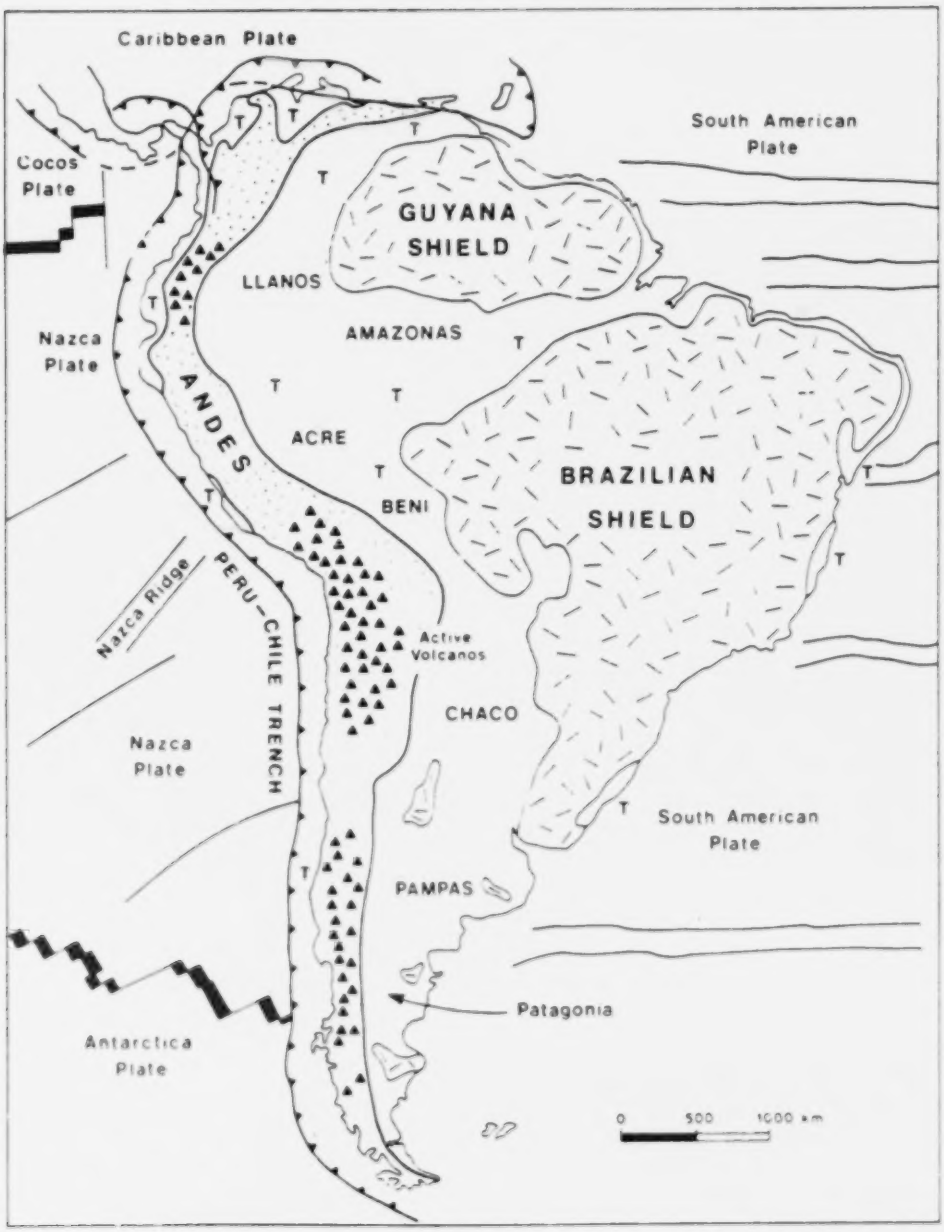

Fig. 5. Key features of South America relevant to baseline study of its modern beach sands.

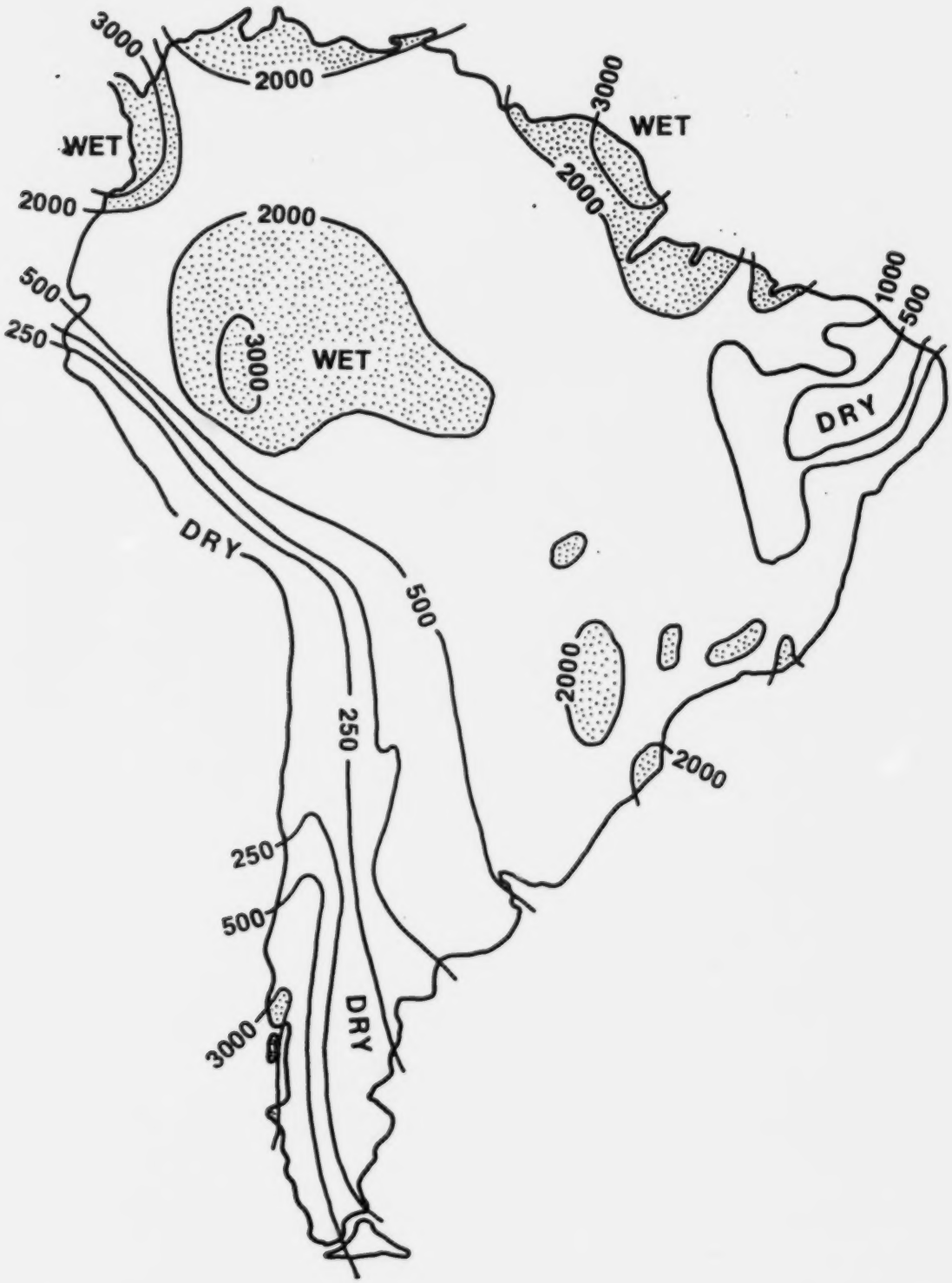

Fig. 6. Rainfall in centimeters.

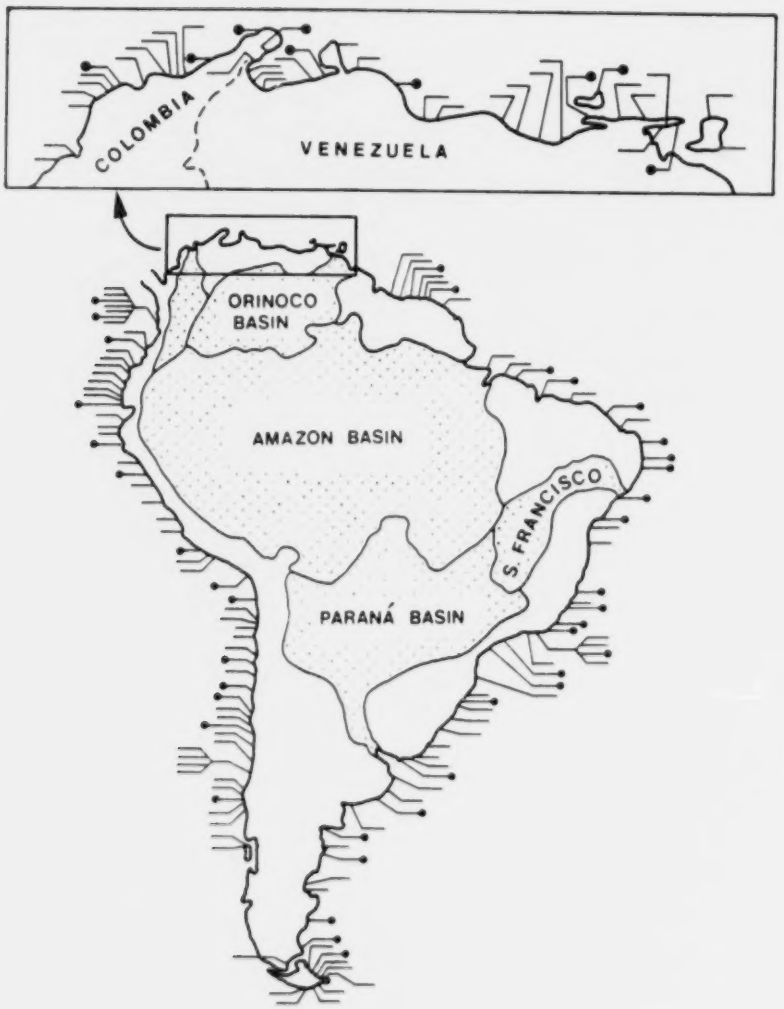

Fig. 7. Beaches sampled and watersheds of South America's major rivers. Black circles indicate duplicate samples from same beach.

Fig. 8. Mineral associations of modern beach sands of South America and average proportions of quartz (Q), feldspar (F) and rock fragments (Rf).

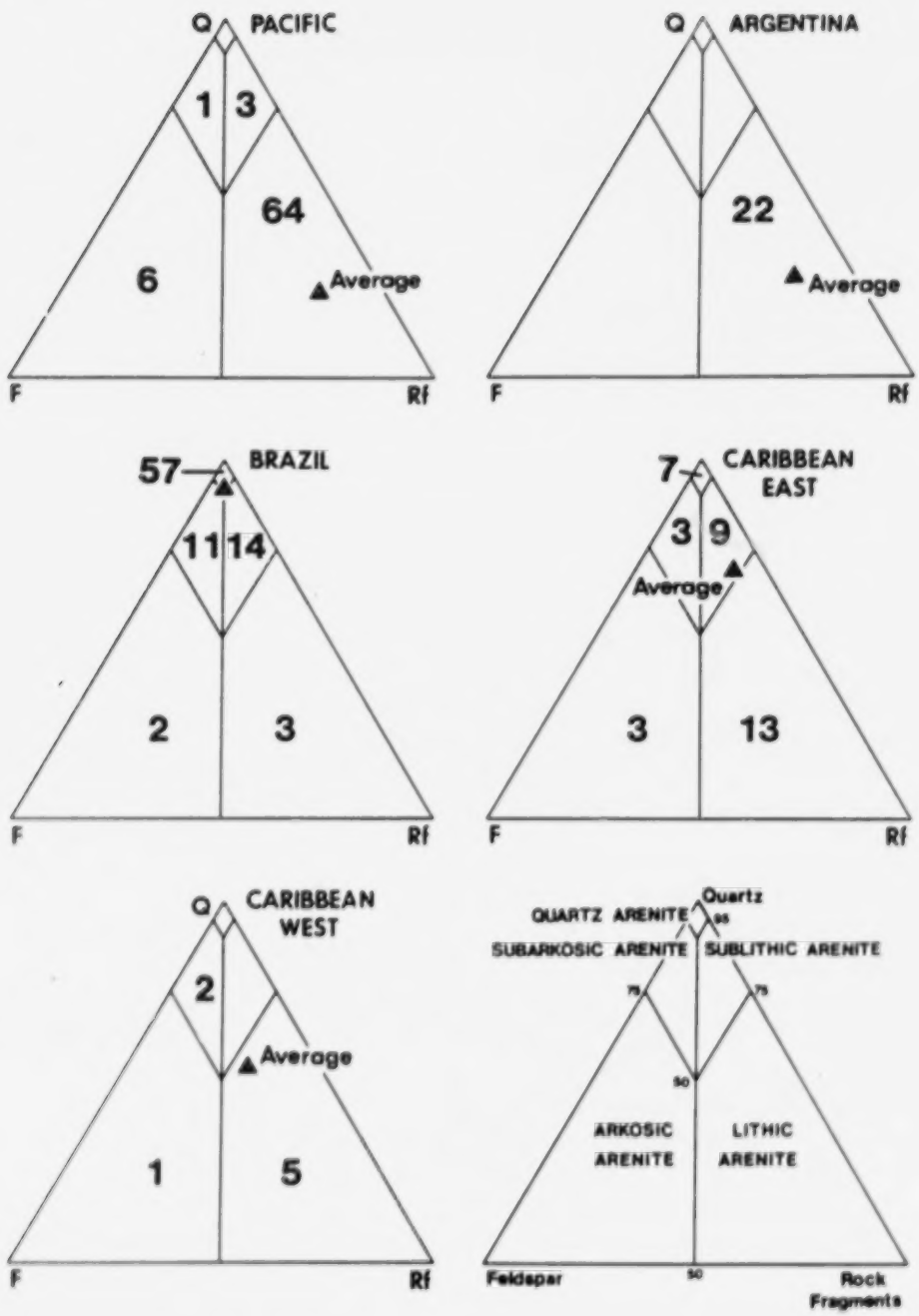

Fig. 9. Mineral associations and petrographic types. Numbers represent samples in each field. Compare with Figure 10.

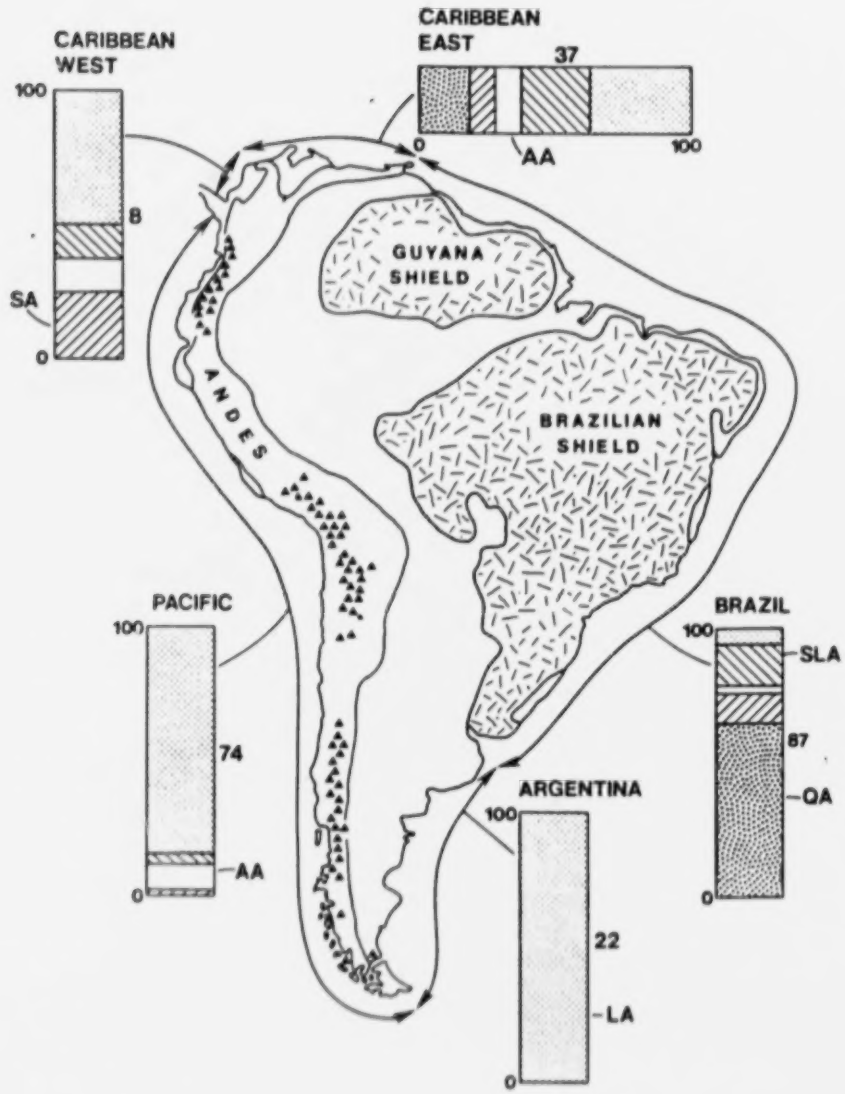

Fig. 10. Bar graphs of rock types and mineral associations.

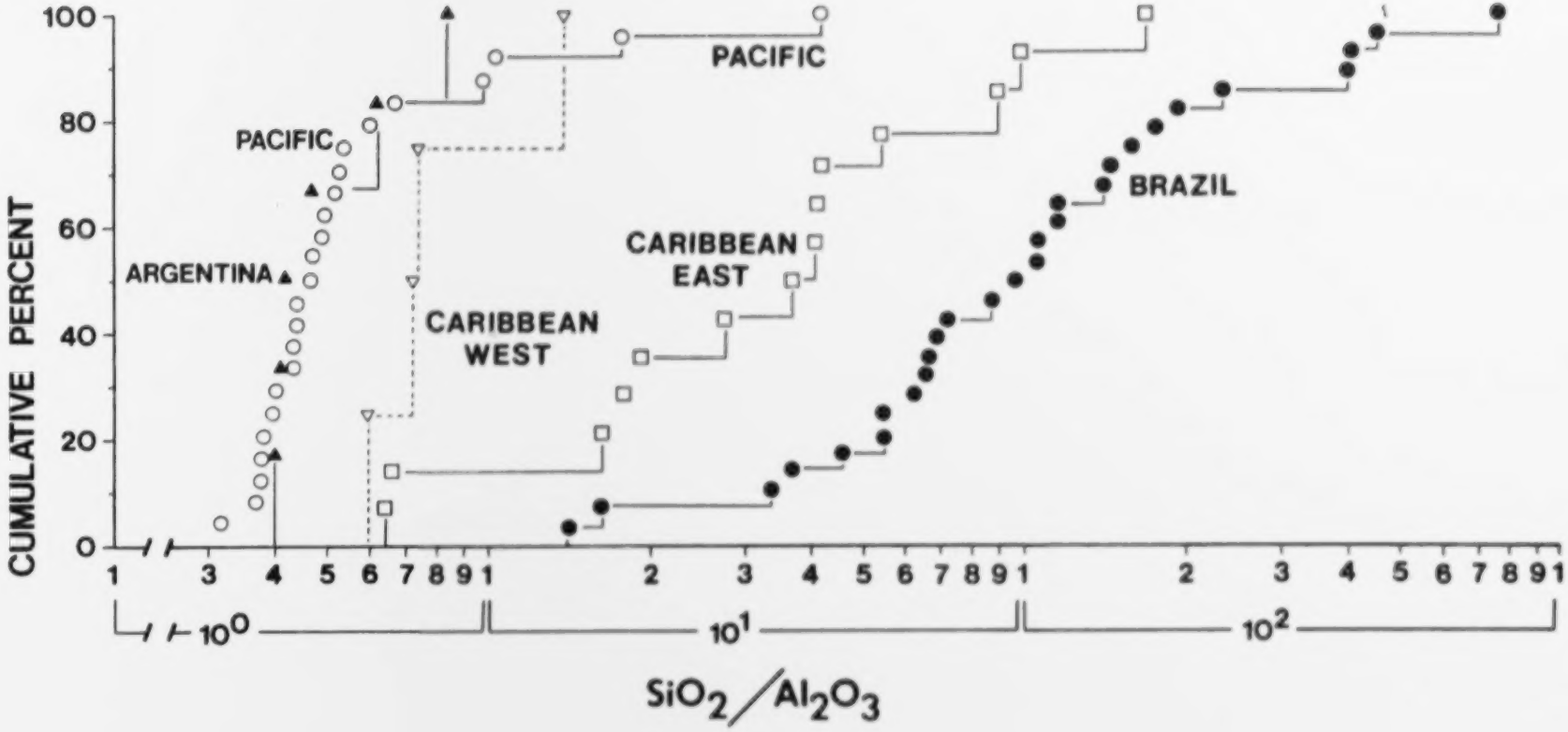

Fig. 11. Stepwise cumulative curves of the Al_2O_3/SiO_2 ratio for the five associations of modern South American beach sands.

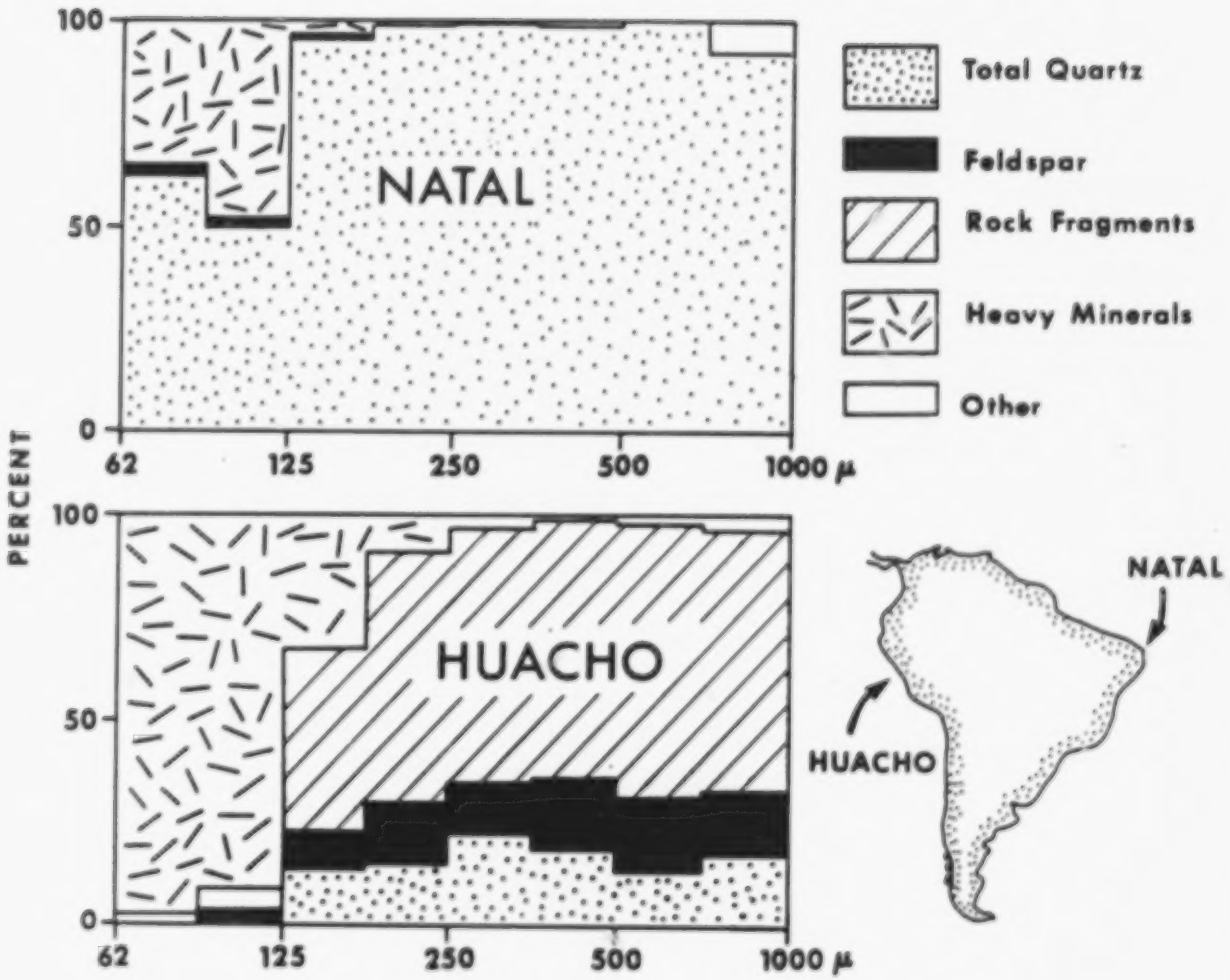

Fig. 12. Contrasting petrology of fraction analysis of passive margin beach sand at Natal, Brazil and of active margin sand at Huacho, Peru.

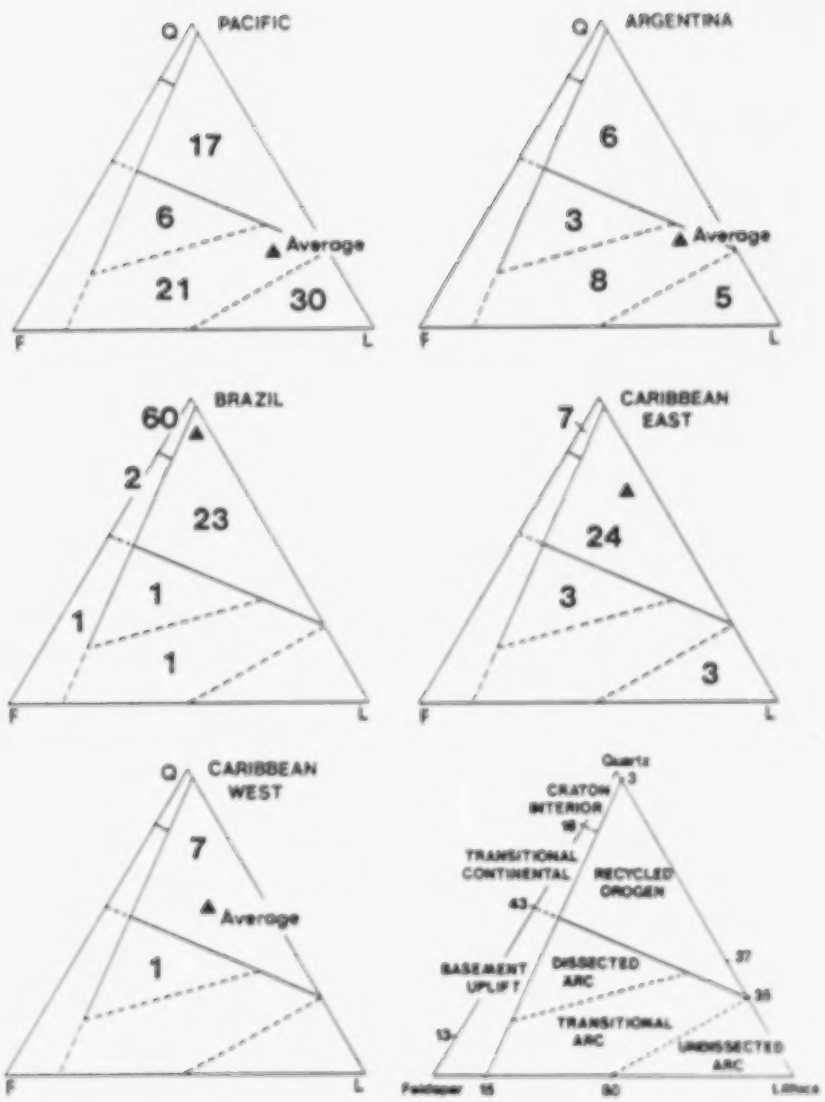

Fig. 13. Average composition of different mineral associations of beach sand using method of Dickinson and others (1983, Fig. 1). Numbers are samples plotting each subfield.

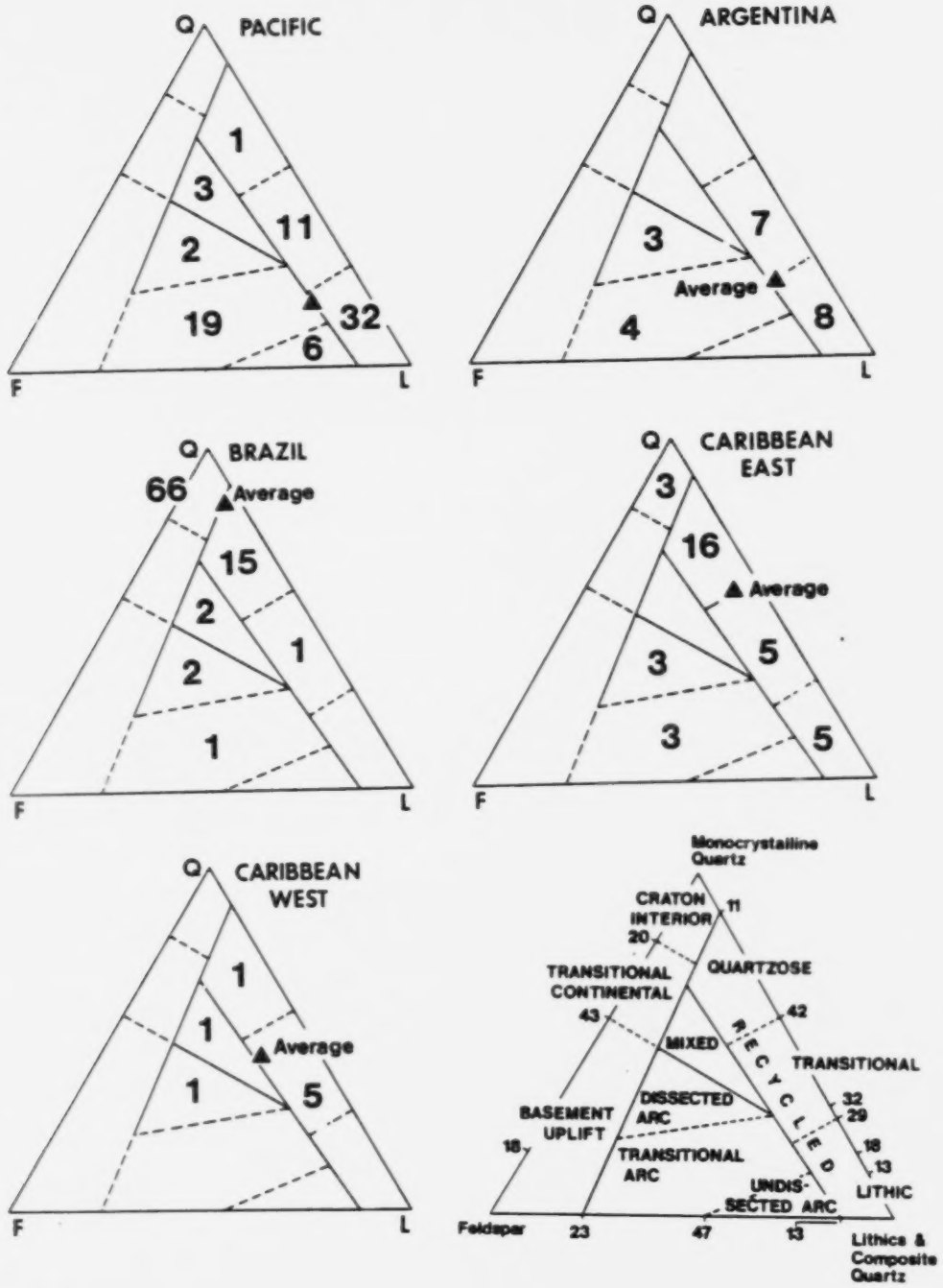

Fig. 14. Average composition of different mineral associations of South America's beach sands using method of Dickinson and others (1983, Fig. 1). Numbers are numbers in each subfield.

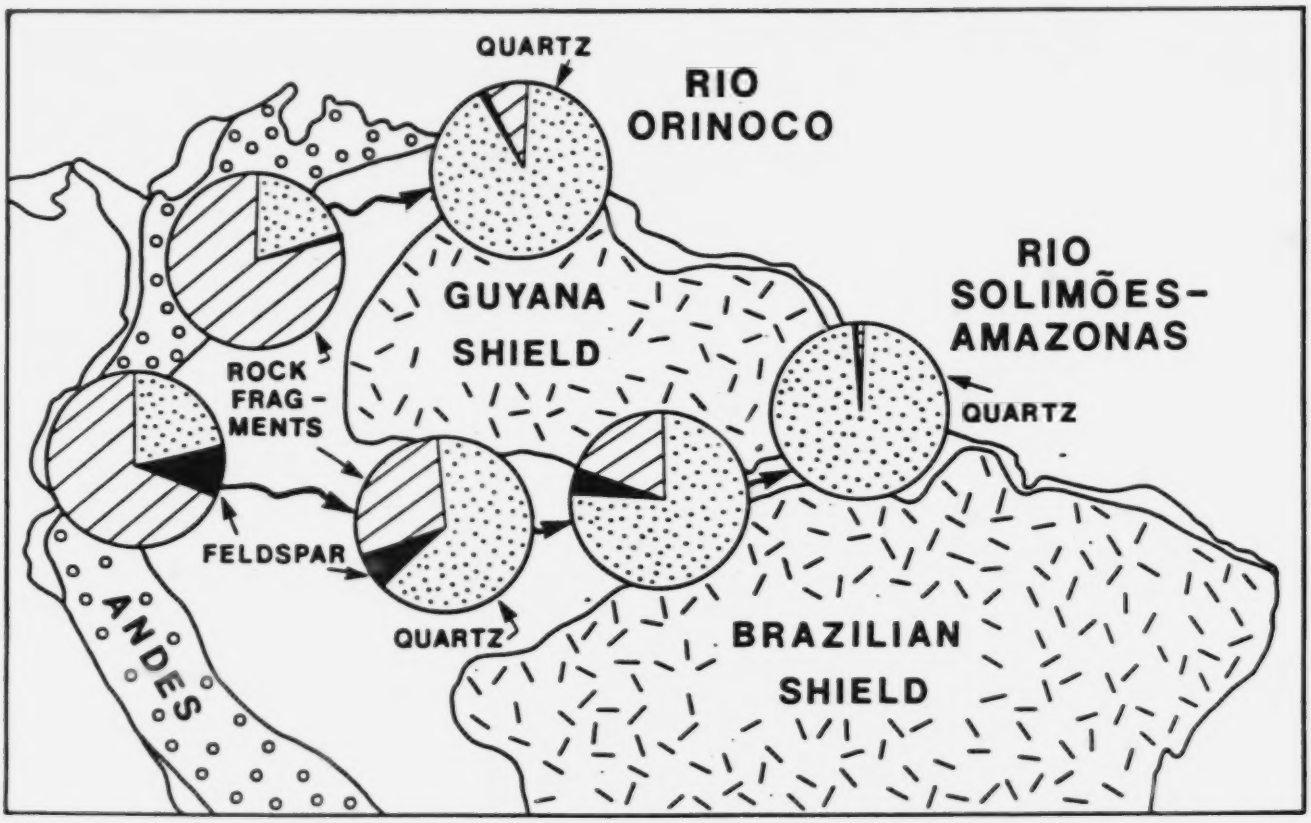

Fig. 15. Changing proportions of quartz (stipple), feldspar (black) and rock fragments (hatchured) from Andean source to Atlantic mouth of South America's two largest rivers. Could this happen in an arid or semi-arid climate?

TABLE 1

MEAN DIFFERENCE AND NINETY PERCENT CONFIDENCE LIMITS FOR QUARTZ, ΔQ; FELDSPAR, ΔF; and ROCK FRAGMENTS, ΔRf AT 27 BEACHES

	ΔQ	ΔF	ΔRf
Mean Difference	6.3	4.1	6.9
Ninety Percent Confidence Limits	8.4 to 2.3	6.3 to 2.2	9.0 to 4.8

TABLE 2

PETROGRAPHIC PARAMETERS OF MODERN SOUTH AMERICAN BEACH SANDS

Part A. Average Proportions and Stand Deviations of Total Quartz (Q), Feldspar (F) and Rock Fragments (Rf)

Association	Q	F	Rf	Samples
Pacific	24±17.9	16±12.8	60±21.7	74
Argentine	28±10.5	14± 9.9	58±16.8	22
Brazil	90±11.8	5± 7.6	5± 7.5	88
Caribbean East	68±24.0	8±10.8	24±21.0	37
Caribbean West	54±10.9	17± 8.7	29±10.9	8

Part B. Petrographic Types

Association	Quartz Arenite	Sub Arkose	Arkose Arenite	Sublithic Arenite	Lithic Arenite	Samples
Pacific	0	1	8	4	87	74
Argentine	0	0	0	0	100	22
Brazil	63	12	2	16	7	88
Caribbean East	10	11	11	24	35	37
Caribbean West	0	25	12	13	50	8

Part C. Selected Ratios

Association	Q_m/Q_t	Q_c/Q_t	Rf %	F_k/F_t	Samples*
Pacific	0.778	0.212	47	0.209	73
Argentine	0.746	0.254	64	0.328	20
Brazil	0.953	0.47	0	0.709	67
Caribbean East	0.800	0.200	1	0.523	30
Caribbean West	0.796	0.224	6	0.463	8

*Sample containing feldspar

Part D. Average Proportion and Standard Deviations of Recombined Variables

Association	Q_m	F_t	$Rf_t Q_c$
Pacific	19±14.3	15±11.2	66±19.0
Argentine	21±11.0	13± 9.8	65±18.1
Brazil	86±16.3	4± 6.2	10±12.7
Caribbean East	54±26.1	8±10.7	38±23.7
Caribbean West	44±12.8	16± 8.9	40±13.6

TABLE 3

AVERAGE CHEMICAL COMPOSITION OF SELECTED SANDS
FROM SOUTH AMERICAN MODERN BEACHES

	Pacific	Argentina	Brazil	Caribbean East and West
SiO_2	61.14	67.17	90.09	78.43
TiO_2	1.09	0.50	2.56	0.25
Al_2O_3	12.59	13.13	10.82	6.01
Fe_2O_3	4.38	3.22	0.31	1.26
FeO	1.68	1.35	0.37	0.32
MnO	0.08	0.15	0.02	0.03
MgO	1.63	1.21	0.40	0.75
CaO	6.33	3.42	3.03	4.21
Na_2O	2.58	2.69	0.36	1.42
K_2O	1.63	1.78	0.27	1.49
P_2O_5	0.21	0.14	0.03	0.07
S	0.07	0.14	0.07	0.07
CO_2	2.22	0.35	2.30	2.70
H_2O^+	0.86	1.17	0.39	0.73
Analyses	4	2	5	3

TABLE 4

AVERAGE COMPOSITION OF RIVER SAND NEAR COAST

Part A - Large Rivers

River, State and Country	Q	F	Rf	Samples	Remarks
Orinoco[1] Bolivia, Venezuela	92	1	8	2	Andean headwaters in Venezuela and Colombia have lithic arenites
Amazon[2] Amapa, Brazil	95	2	3	2	Andean headwaters in Colombia, Ecuador, Peru and Bolivia have lithic arenites with typical average of 46:8:46
Tocantins[2]	94	2	4	1	Little data in watershed, but igneous and metamorphic rocks of Brazilian Shield covered by rain forest and savannah
San Francisco[1] Sergipe, Alagoas, Brazil	97	2	1	5	No data but metamorphic, igneous and sedimentary rocks on watershead; semi-arid climate
Parana[1]	97	2	1	4	Great variation from granites and basalts and sediments in Brazil to inferred lithic arenites in rivers draining Andes in Argentina and Bolivia, plus wide variation from savannah to jungle.

Part B - Small Rivers

Guana Para, Brazil	96	1	3	1	Crystalline rocks of Brazilian Shield and Maranhao Basin
Paria Para, Brazil	95	3	2	1	Tertiary cover of Brazilian Shield
Gurupi Para, Brazil	96	1	3	1	Sediments of Maranhao Basin plus crystalline rocks of Brazilian Shield
Parnaiba Piau, Brazil	98	1	1	1	Sediments of Maranhao Basin

TABLE 4 - Continued

Part B - Small Rivers

	Q	F	Rf	Samples	Remarks
Itanhem Bahia, Brazil	98	1	1	2	Metamorphic and igneous from the Brazilian Shield and Tertiary sandstones and conglomerates.
Paraiba do Sul Rio de Janeiro, Brazil	85	13	2	4	Crystalline rocks of Brazilian Shield and semi-arid climate. Beach sands of delta average 90:8:2
Doce[3)] Espiuto Santo, Brazil					Crystalline rocks of Serra do Mar. Beach sands of delta average

1) Potter (1978)

2) Franzinelli and Potter (1983)

3) Coutinho (1974)

APPENDIX I

Sample Location List

of

MODERN BEACH AND RIVER SANDS OF SOUTH AMERICA
(Amazon Basin Excluded)

By

Paul Edwin Potter
H. N. Fisk Laboratory of Sedimentology
University of Cincinnati
Cincinnati, Ohio 45221
U.S.A.

May 1984

The majority of the beach sands were obtained from February 1981 to December 1983 on Grant EAR 801-8209 from the National Science Foundation, although a few samples were obtained as early as 1974. Individuals and organizations that are listed below provided samples and logistic support.

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Esso Inter America, Miami, Florida, USA

Gilbert Pommier and J. M. Fonck
Total Austral, Buenos Aires, Buenos Aires Prov.

Fredrico Isla
Centro de Geologia de Costas, Mar del Plata

Brazil

Roberto Porto, Peter Szatmari, Celso Ponte, Jonas Fonseca, J. J. de Oliveira, Nelson da Silva, J. B. B. Ribeiro and Joel de Castro
PETROBRÁS, Rio de Janeiro

Rev. Robert M. Marvin
Parnaíba, Piauí

Luis R. Martins
Centro de Estudios Costeiros e Oceanográficos, UFRGS,
Porto Alegre, Rio Grande do Sul

Cláudio Castro
Geologia, Universidade Federal de Pernambuco, Recife
Pernambuco

Robert Korpershoek, Consultant
Rio de Janeiro, R.J.

Elena Franzinelli
Universidade do Amazonas, Manaus, Amazonas

Antonio Tancredi
IDESP, Instituto Desenvolvimento Economico Social do
Pará, Belém do Pará, Pará

Nelson da Silva
Consultant, Rio de Janeiro, R. J.

Chile

Juan Varela B., Eduardo Valenzuela, R. Charrier, R. Thiele
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M. Sourdat
ORSTROM, Quito

French Guiana

Elena Franzinelli
Universidade do Amazonas, Manaus, Brazil

Peru

Peter Grijalba V. and Fred Majocha
Belco Petroleum, Lima and New York

Eugene R. Herring III, L. L. Düncker, James Swarbrick
Occidental Peruana, Lima

Suriname

P. F. E. G. Augustinas
Department of Physical Geography
Rijksuniversiteit, Utrecht, The Netherlands

Trinidad

Patrick Gooding
Kentucky Geological Survey, Lexington, Kentucky, USA

Uruguay

Capitan Juan A. Robatto
Servicio Oceanografía, Hidrografía y Meteorología de la Armada, Montevideo

Venezuela

Nicolas G. Muñoz, J.
Departmento de Geología, Universidad Central, Caracas, D. F.

Guenter Meier
E. J. DuPont and Nemours, Wilmington, Delaware, U.S.A.

Betsy Thomas
Connecticut, U.S.A.

PC-229 MODERN RIVER SAND, Rio Paraná, at Zarate, Prov. de Buenos Aires, República Argentina

PC-296 MODERN RIVER SAND, Magdalena River below mouth of Baranquilla, Atlántico, Colombia; Arnold Bouma

PC-336 MODERN RIVER SAND, Orinoco River at Ciudad Bolivar, Estado de Bolivar, Venezuela

PC-337 MODERN RIVER SAND, Orinoco River, San Felix, Estado de Monangas, Venezuela

PC-339 MODERN BEACH SAND, Delta of Rio São Francisco, Sergipe, Brazil; P. E. Potter, 1974

PC-340 MODERN BEACH SAND, Delta of Rio São Francisco, Sergipe, Brazil; P. E. Potter, 1974

PC-341 MODERN BEACH SAND, Delta of Rio São Francisco, Sergipe, Brazil; P. E. Potter, 1974

PC-342 MODERN BEACH SAND, Delta of Rio São Francisco, Alagoas, Brazil; P. E. Potter, 1874

PC-343 MODERN BEACH SAND, Delta of Rio São Francisco, Alagoas, Brazil; P. E. Potter, 1974

PC-344 MODERN BEACH SAND, Delta of Rio São Francisco, Alagoas, Brazil; P. E. Potter, 1974

PC-345 MODERN RIVER SAND, Delta of Rio São Francisco, Sergipe - Alagoas, Brazil; P. E. Potter, 1974

PC-346 MODERN RIVER SAND, Delta of Rio São Francisco, Sergipe - Alagoas, Brazil; P. E. Potter, 1974

PC-347 MODERN RIVER SAND, Delta of Rio São Francisco, Sergipe - Alagoas, Brazil; P. E. Potter, 1974

PC-348 MODERN RIVER SAND, Delta of Rio São Francisco, Sergipe - Alagoas, Brazil; P. E. Potter, 1974

PC-349 MODERN RIVER SAND, Delta of Rio São Francisco, Sergipe - Alagoas, Brazil; P. E. Potter, 1974

PC-350 MODERN RIVER SAND, Delta of Rio São Francisco, Sergipe - Alagoas, Brazil; P. E. Potter, 1974

PC-351 MODERN RIVER SAND, Delta of Rio São Francisco, Sergipe - Alagoas, Brazil; P. E. Potter, 1974

PC-354 MODERN RIVER SAND, Rio Paraná, San Pedro, Prov. Buenos Aires, República Argentina; J. C. Riggi, 1973

PC-355 MODERN RIVER SAND, Rio Paraná, Ramallo, Prov. Buenos Aires, República Argentina; J. C. Riggi, 1973

PC-358 MODERN BEACH SAND, São João da Barra near Campos, Rio de Janeiro, Brazil, (Delta of Rio Paraíba); P. E. Potter, 1974

PC-359 MODERN BEACH SAND, Nossa Senhora de Fatima near Ing. São Pedro, east of Campos, Rio de Janeiro, Brazil (Delta of Rio Paraíba); P. E. Potter, 1974

PC-360 MODERN BEACH SAND, Farol de São João da Barra, east of Campos, Estado do Rio de Janeiro, Brazil (Delta of Rio Paraíba); P. E. Potter, 1874

PC-361 MODERN BEACH SAND, at Grussai (Delta of Rio Paraíba), Estado do Rio de Janeiro, Brazil; P. E. Potter, 1974

PC-366 MODERN BEACH SAND, São Tomé, Farol de São Tomé, east of Campos, Rio de Janeiro, Brazil (Delta of Rio Paraíba); P. E. Potter, 1974

PC-367 MODERN RIVER SAND, Rio de Janeiro, Brazil (Delta of Rio Paraíba); P. E. Potter, 1974

PC-368 MODERN RIVER SAND, Rio de Janeiro, Brazil (Delta of Rio Paraíba); P. E. Potter, 1974

PC-369 MODERN RIVER SAND, Rio de Janeiro, Brazil (Delta of Rio Paraíba); P. E. Potter, 1974

PC-370 MODERN RIVER SAND, Rio de Janeiro, Brazil (Delta of Rio Paraíba); P. E. Potter, 1974

PC-373 MODERN BEACH SAND, Salinópolis, Pará, Brazil; Francisco Bezerra da Cunha, 1976

PC-513 MODERN BEACH SAND, Cabo Maguari, northeast corner of Ilha Marajó, Pará, Brazil. Lat. 0°16'47"S; Long. 41°15'00"W; Elena Franzinelli, 1977

PC-540 MODERN RIVER SAND, Rio Paraquai sand dredged from bottom, Corumbá, Mato Grosso do sul, Brazil; P. E. Potter, 1974

PC-545 MODERN RIVER SAND, Rio Paraíba do Sul, 5 km from Santa, Rio de Janeiro, Brazil. Lat. 43°00'W, Long. 22°02'S

PC-546 MODERN RIVER SAND, Rio Paraná, Presidente Epitácio, São Paulo, Brazil; Joel de Castro, 1977

PC-547 MODERN RIVER SAND, Rio Apa, Bela Vista, Mato Grosso do Sul, Brazil; Joel de Castro, 1977

PC-548 MODERN BEACH SAND, at Bahia de Cata east of Puerto Cabello, Estado de Aragua, Venezuela; N. Muñoz

PC-549 MODERN BEACH SAND, Torres (Guarita), Rio Grande do Sul, Brazil; Luís Martins

PC-579 MODERN RIVER SAND, Rio Arenillas, Canton Arenilles, Prov. El Oto, Peru. Contributed by OSTROM.

PC-625 MODERN BEACH SAND (one of two); Necochea, Prov. Buenos Aires, República Argentina; P. E. Potter, 1981

PC-626 MODERN BEACH SAND (two of two); Necochea, Prov. Buenos Aires, República Argentina; P. E. Potter, 1981

PC-627 MODERN BEACH SAND, Punta Loyola, near Rio Gallegos, Prov. Santa Cruz, República Argentina; P. E. Potter, 1981

PC-628 MODERN BEACH SAND, Punta Loyola, near Rio Gallegos, Prov. Santa Cruz, República Argentina, P. E. Potter, 1981

PC-629 MODERN RIVER SAND, from Rio Chubut and Argentina Hwy 3, Prov. Chubut, República Argentina ; P. E. Potter, 1981

PC-630 MODERN BEACH SAND, Puerto Madryn, Prov. Chubut, República Argentina; P. E. Potter, 1981

PC-631 MODERN BEACH SAND (one of two); Playa de la Unión, Rawson, Prov. Chubut, República Argentina ;P. E. Potter, 1981

PC-632 MODERN BEACH SAND, Guarapari, Espírito Santo, Brazil; Elena Franzinelli, 1979

PC-633 MODERN BEACH SAND, Guarapari, Espírito Santo, Brazil; Elena Franzinelli, 1979

PC-634 MODERN RIVER SAND, Río Coyle and Argentina Hwy 3, Prov. Santa Cruz, República Argentina ; P. E. Potter, 1981

PC-635 MODERN RIVER SAND, Río Santa Cruz and Argentina Hwy 3, Prov. Santa Cruz, República Argentina ; P. E. Potter, 1981

PC-636 MODERN RIVER SAND, Río Chico and Argentina Hwy 3, Prov. Santa Cruz, República Argentina; P. E. Potter, 1981

PC-637 MODERN BEACH SAND, (two of two), Playa de la Unión, Rawson, Prov. Chubut, República Argentina ; P. E. Potter, 1981

PC-638 MODERN BEACH SAND, Praia do norte da Ilha Picano, Município Braganca, Pará, Brazil. Lat. 00°48'51"S; Long. 46°45'59"W; (SA.23-V-A); Elena Franzinelli, 1978

PC-639 MODERN BEACH SAND, Caleta Olivia, Prov. Santa Cruz, República Argentina; P. E. Potter, 1981

PC-640 MODERN RIVER SAND, Río Deseado and Argentina Hwy 3, Prov. Santa Cruz, República Argentina; P. E. Potter, 1981

PC-641 MODERN BEACH SAND, Monte Hermosa, Prov. Buenos Aires, República Argentina; P. E. Potter, 1981

PC-642 MODERN BEACH SAND (one of two), Rada Tilly, Prov. Chubut, República Argentina; P. E. Potter, 1981

PC-643 MODERN BEACH SAND (two of two), Rada Tilly, Prov. Chubut, República Argentina ; P. E. Potter, 1981

PC-644 MODERN BEACH SAND, Mar Chiquita, east of Mar del Plata, Prov. Buenos Aires, República Argentina; P. E. Potter, 1981

PC-645 MODERN BEACH SAND, Cabo Curioso, north of San Julián, Prov. Santa Cruz, República Argentina; P. E. Potter, 1981

PC-646 Sand from Holocene Pits, Punta Loyola, near Rio Gallegos, Prov. Santa Cruz, República Argentina; P. E. Potter, 1981

PC-647 MODERN BEACH SAND, Port of Ushuaia, Tierra del Fuego, República Argentina; Marcelo Yrigoyen, 1981

PC-648 MODERN BEACH SAND, La Pinguinera, Dungeness Point, Prov. Santa Cruz, República Argentina , Lat. 52°23'S; Long. 68°25'W; M. Yrigoyen, 1981

PC-649 MODERN BEACH SAND, at Cassino, Município de Rio Grande, Rio Grande do Sul, Brazil; L. Martins, 1981

PC-650 MODERN RIVER SAND, from Arroyo Verde y Argentina Hwy 3, Prov. Chubut, República Argentina; P. E. Potter, 1981

PC-651 MODERN BEACH SAND, Mostardas, Município de Mostardas, Rio Grande do Sul, Brazil; L. Martins, 1981

PC-652 MODERN BEACH SAND, Guarita, Município de Torres, Rio Grande do Sul, Brazil; L. Martins, 1981

PC-653 MODERN BEACH SAND, Namorados, Guarapari near Vitória, Espírito Santo, Brazil; L. Martins, 1981

PC-654 MODERN BEACH SAND, Praia da Barra, Salvador, Bahia, Brazil; L. Martins, 1981

PC-655 MODERN BEACH SAND, Santa Vitória do Palmar near Chuí, Rio Grande do Sul, Brazil; L. Martins, 1981

PC-656 MODERN RIVER SAND, Rio Paraná at Capital Bermudez, Prov. de Santa Fe, República Argentina; J. C. Riggi, 1981

PC-659 MODERN BEACH SAND, Santa Teresita, Prov. Buenos Aires, República Argentina (36°31'S; 56°41'W); Dr. Schnack, 1981

PC-660 MODERN BEACH SAND, Capão da Canoa, Osório, Rio Grande do Sul, Brazil; L. Martins, 1981

PC-661 MODERN BEACH SAND, Barra do Ribeira, east of Iguape, São Paulo, Brazil (one of two); P. E. Potter, 1981

PC-662 MODERN BEACH SAND, Barra do Ribeira, east of Iguape, São Paulo, Brazil (two of two); P. E. Potter, 1981

PC-663 MODERN BEACH SAND, Praia Grande, Santos, São Paulo, Brazil; P. E. Potter, 1981

PC-664 MODERN BEACH SAND, Morro dos Conventos, Município de Araranguá, Santa Catarina, Brazil; L. Martins, 1981

PC-665 MODERN BEACH SAND, Bahia de San Julián, San Julián, Prov. Santa Cruz, República Argentina; P. E. Potter, 1981

PC-666 MODERN BEACH SAND, Praia da Pina, Município de Recife, Pernambuco, Brazil; L. Martins, 1981

PC-667 MODERN DUNE SAND, Cabo Curioso, north of San Julián, Prov. Santa Cruz, República Argentina; P. E. Potter, 1981

PC-668 MODERN BEACH SAND, Praia Grande, east of Santos, São Paulo, Brazil; P. E. Potter, 1981

PC-669 MODERN BEACH SAND, Praia de Campurupim, Mundo Novo near Barra de Tabatinga, Município de Nísia Floresta, Rio Grande do Norte, brazil; J. B. B. Ribeiro e F. J. O. Costa, 1981 (No. 1)

PC-670 MODERN BEACH SAND, Praia de Mundo Novo near Barra de Tabatinga, Município de Nísia Floresta, Rio Grande do Norte, Brazil; J. B. B. Ribeiro e F. J. O. Costa, 1981 (No. 2)

PC-671 MODERN BEACH SAND, Praia de Barra de Tabatinga near Búzios, Município de Nísia Floresta, Rio Grande do Norte, Brazil; J. B. B. Ribeiro e Costa, 1981 (No. 3)

PC-672 MODERN BEACH SAND, Praia Ponta de Búzios near Pirangi do Sul, Município de Nísia Floresta, Rio Grande do Norte, Brazil; J. B. B. Ribeiro e Costa, 1981 (No. 4)

PC-673 MODERN BEACH SAND, Praia de Búzios at Búzios near Pirangi do Sul, Município de Nísia Floresta, Rio Grande do Norte, Brazil; J. B. B. Ribeiro e Costa, 1981 (No. 5)

PC-674 MODERN BEACH SAND, Praia de Pirangi do Sul, near Pirangi do Norte, Município de Nísia Floresta, Rio Grande do Norte, Brazil; J. B. B. Ribeiro e Costa, 1981 (No. 6)

PC-675 MODERN BEACH SAND, Praia de Pirangi do Norte, near Cotovelo, Município de Eduardo Gomes, Rio Grande do Norte, Brazil; J. B. B. Ribeiro e F. J. O. Costa, 1981 (No. 7)

PC-676 MODERN BEACH SAND, Praia de Cotovelo, Pium, Município de Eduardo Gomes, Rio Grande do Norte, Brazil; J. B. B. Ribeiro e F. J. O. Costa, 1981 (No. 8)

PC-677 MODERN BEACH SAND, Praia Ponte Negra, Ponta Negra, Município de Natal, Rio Grande do Norte, Brazil; J. B. B. Ribeiro e F. J. O. Costa, 1981 (No. 9)

PC-678 MODERN BEACH SAND, Praia de Mãe Luíza, Município de Natal, Rio Grande do Norte, Brazil; J. B. B. Ribeiro e F. J. O. Costa, 1981 (No. 10)

PC-679 MODERN BEACH SAND, Praia de Areia Preta, Município de Natal, Rio Grande do Norte, Brazil; J. B. B. Ribeiro e F. J. O. Costa, 1981 (No. 11)

PC-680 MODERN BEACH SAND, Praia dos Artistas, Orla Marítima, Município de Natal, Rio Grande do Norte, Brazil; J. B. B. Ribeiro e F. J. O. Costa, 1981 (No. 12)

PC-681 MODERN BEACH SAND, Praia do Meio, Orla Marítima, Município de Natal, Rio Grande do Norte, Brazil; J. B. B. Ribeiro e F. J. O. Costa, 1981 (No. 13)

PC-682 MODERN BEACH SAND, Praia do Forte, Orla Marítima, Município de Natal, Rio Grande do Norte, Brazil; J. B. B. Ribeiro e F. J.O. Costa, 1981 (No. 14)

PC-683 MODERN BEACH SAND, Praia de Redinha, Município de Natal, Rio Grande do Norte, Brazil; J. B. B. Ribeiro e F. J. O. costa, 1981 (No. 15)

PC-684 MODERN BEACH SAND, Praia de Genipabu, Genipabu, Município de Extremoz, Rio Grande do Norte, Brazil; J. B. B. Ribeiro e F. J. O. Costa, 1981 (No. 16)

PC-685 MODERN BEACH SAND, Luiz Correas, Município de Parnaíba, Piauí, Brazil; P. E. Potter, 1981

PC-686 MODERN BEACH SAND, Ilhéus, Bahia, Brazil; P. E. Potter, 1981

PC-687 MODERN BEACH SAND, Praia de Ipitanga, Lauro de Freitas, north of airport at Salvador, Bahia, Brazil; P. E. Potter, 1981

PC-688 MODERN BEACH SAND, Praia Vilas do Atlântico, Lauro de Freitas, north of airport at Salvador, Bahia, Brazil; P. E. Potter, 1981

PC-689 MODERN BEACH SAND, delta of Rio Camamu in 1 meter of water, 4 km east-northeast of Camamu, Município de Camamu, Bahia, Brazil; Sérgio Netto, 1981

PC-690 MODERN BEACH SAND, Praia do Futuro, Fortaleza, Ceará, Brazil; P. E. Potter, 1981 (one of one)

PC-691 MODERN BEACH SAND, Jaguarema, Ilha de São Luís, Maranhão, Brazil; P. E. Potter, 1981 (one of two)

PC-692 MODERN BEACH SAND, Jaguarema, Ilha de São Luís, Maranhão, Brazil; P. E. Potter, 1981 (two of two)

PC-694 MODERN BEACH SAND, Praia Vermelha, Urca, Rio de Janeiro, Rio de Janeiro, Brazil; Mrs. H. Koerpershoek, 1981

PC-695 MODERN BEACH SAND, coastal barrier. Sample M4, 1.5 m deep, east of Mattapica Canal about 30 km southeast of mouth of Suriname River, Suriname. Lat. 5°, 59'N); Long. 54°41.5'; James Rine, 1978

PC-696 MODERN BEACH SAND, active coastal barrier. Sample M4, 0.6 to 0.7 m deep, east of Mattapicca Canal about 30 km southeast of mouth of Suriname River, Suriname. Lat. 5°55'N; Long. 54°41.5'W; James Rine, 1978

PC-697 MODERN BEACH SAND, sample P-10, 1.85 m deep. Barrier beach on young coastal plain about 8 km northwest of junction of Comewijne and Suriname Rivers, Suriname. Lat. 5°51.8N; Long. 55°13.8'W; James Rine, 1978

PC-698 MODERN BEACH SAND, barrier beach on young coastal plain. Sample from Core P-13 at 1.3 m. Core about 8 km northwest of junction of Comewijne and Suriname Rivers, Suriname. Lat. 5°51.8N; Long. 55°13.8W; James Rine, 1978

PC-699 MODERN BEACH SAND, Praia of Marambaia west of Rio de Janeiro, Rio de Janeiro, Brazil; P. E. Potter, 1978

PC-700 MODERN BEACH SAND, Unnamed playa about 1 hour west of Los Caracas, Distrito Federal, Venezuela; G. Meier, 1978

PC-701 MODERN BEACH SAND, praia at Cabo Frio, Município de Cabo Frio, Rio de Janeiro, Brazil; Nelson da Silva, 1979

PC-702 MODERN BEACH SAND, praia at Cabo Frio, Município de Cabo Frio, Rio de Janeiro, Brazil; Nelson da Silva, 1979

PC-703 MODERN BEACH SAND, Puerto Cayo, Prov. Manabi, Ecuador. Lat. 80°40W, Long. 1°20S; OSTROM

PC-704 MODERN BEACH SAND, at right of Santa Lucía River, Punta Espinillo, Uruguay, Lat. 34°50S; Long. 56°25'W; Juan C. Rabatto, 1981

PC-705 MODERN BEACH SAND, Punta del Este, Uruguay, Lat. 34°55'S; Long. 54°56'W; Juan C. Rabatto, 1981

PC-706 MODERN BEACH SAND, to left of Santa Lucía River, Playa Pascal, Uruguay, Lat. 34°45'S; Long. 56°27'W; Capitan J. C. Rabatto, 1981

PC-707 MODERN BEACH SAND, Cabo Santa María, Uruguay, Lat. 34°40'S; Long. 34°10'W; Capitan J. C. Rabatto, 1981

PC-708 MODERN BEACH SAND, Beach at Tibau, Rio Grande do Norte, Brazil; Cláudio de Castro, 1979

PC-709 MODERN BEACH SAND, Praia Boa Viagem, Recife, Pernambuco, Brazil; Cláudio de Castro, 1979

PC-710 MODERN BEACH SAND, Beach of delta of Rio Doce (1-RD-2-ES,02) about 1 km from Montante, Espírito Santo, Brazil; Petrobras and Jonas Fonseca, 1981

PC-711 MODERN BEACH SAND, Beach of delta of Rio Doce near well 1-RD-2-ES-01, Espírito Santo, Brazil; Petrobras and Jonas Fonseca, 1981

PC-712 MODERN BEACH SAND, Cabedelo, Paraíba, Brazil; Cláudio de Castro, 1978

PC-713 MODERN BEACH SAND, Beach at Cabo Branco Joao Pessoa, Paraíba, Brazil; Cláudio de Castro, 1978

PC-714 MODERN RIVER SAND, Magdalena River southeast of Simiti, Bolivar, Colombia; Douglas Jordan, 1980

PC-715 MODERN BEACH SAND, Praia Seca, Município de Araruama, Rio de Janeiro, Rio de Janeiro, R. J., Lat. 22.93°S, Long. 42.31°W; P. Szatmari, 1981

PC-718 MODERN BEACH SAND, Playa at El Caramelo, Prov. La Libertad, Perú (one of two); P. E. Potter, 1981

PC-719 MODERN BEACH SAND, Playa at El Caramelo, Prov. La Libertad, Peru'(one of two); P. E. Potter, 1981

PC-720 MODERN RIVER SAND, Rio Parnaíba at Parnaíba, Piauí, Brazil; Rev. Robert Marvin, 1981

PC-721 MODERN BEACH SAND, Playa at Pascamayo, Prov. La Libertad, Perú; P. E. Potter, 1981

PC-722 MODERN BEACH SAND, Playa at Puerta de Lomas, Prov. Arequipa, Perú (one of two); P. E. Potter, 1981

PC-723 MODERN BEACH SAND, Playa at Puerta de Lomas, Prov. Arequipa, Peru'(two of two); P. E. Potter, 1981

PC-724 MODERN BEACH SAND, Playa at León Dormido, about 3 km north of San Antonio, Prov. Lima, Perú; P. E. Potter, 1981

PC-725 MODERN BEACH SAND, Playa at Paracas, Prov. Ica, Perú; P. E. Potter, 1981

PC-726 MODERN BEACH SAND, Playa at Talara, Prov. Piura, Perú; P. E. Potter, 1981

PC-727 MODERN BEACH SAND, Playa at Zorritos, Prov. Tumbes, Perú; P. E. Potter, 1981

PC-728 MODERN BEACH SAND, Playa at Zorritos, Prov. Tumbes, Perú; James Swarbuck, 1981

PC-729 MODERN BEACH SAND, Playa at Tortugas, Prov. Lancasli, Perú; P. E. Potter, 1981

PC-730 MODERN BEACH SAND, Playa near Punta Aguja, Prov. Piura, Perú (one of two); P. E. Potter, 1981

PC-731 MODERN BEACH SAND, Playa near Punta Aguja, Prov. Piura, Perú (one of two); P. E. Potter, 1981

PC-732 MODERN BEACH SAND, Playa about 20 km south of Chala, Prov. Arequipa, Perú; P. E. Potter, 1981

PC-733 MODERN BEACH SAND, Playa at Atico, Prov. Arequipa, Perú; P. E. Potter, 1981

PC-734 MODERN BEACH SAND, Playa at Huacho, Prov. Lima, Perú; P. E. Potter, 1981

PC-735 MODERN BEACH SAND, Playa de Yarada, Prov. Tacna, Perú (sample 38, 0-20 cm of Señorita Dunckner and collected by her in 1981)

PC-736 MODERN BEACH SAND, Playa de Inglesa, Prov. Tacna, Perú (sample 8, 0-20 cm Señorita Dunckner and collected by her in 1981)

PC-737 MODERN BEACH SAND, Playa at La Libertad near Santa Elena, Prov. Guayas, Ecuador; P. E. Potter, 1981 (one of two about 2 km apart)

PC-738 MODERN BEACH SAND, Playa at La Libertad, near Santa Elena, Prov. Guayas, Ecuador; P. E. Potter, 1981 (two or two collected about 2 km apart)

PC-739 MODERN BEACH SAND, Playa at Manglaralto, Prov. Guayas, Ecuador; P. E. Potter, 1981

PC-740 MODERN BEACH SAND, Playa at Entrada, 14 km north of Manglaralto, Prov. Guayas, Ecuador; P. E. Potter, 1981

PC-741 MODERN BEACH SAND, Playa Vermelha, Rio de Janeiro, Brazil; Mrs. R. Korpershoek, 1981

PC-742 MODERN BEACH SAND, Playa on Tierra del Fuego, República Argentina. Alt. 54°39'14"S; Long. 65°47'12"W (sample 102 of Al Sawyer and collected by him in 1981)

PC-743 MODERN BEACH SAND, Playa on Tierra del Fuego, Lat. 54°24'08"S, 66°33'16"W, República Argentina; (sample collected by Al Sawyer in July 1981)

PC-744 MODERN BEACH SAND, Playa on Tierra del Fuego, Lat. 54°03'11"S, Long. 67°18'17"W, República Argentina; (sample 104 collected by Al Sawyer in 1981)

PC-745 MODERN BEACH SAND, Playa on Tierra del Fuego, República Argentina , Lat. 53°20'04"S, Long. 68°08'02"W; Al Sawyer, 1981

PC-746 MODERN BEACH SAND, Bahia de Cata east of Puerto Cabello, Aragua, Venezuela; N. G. Muñoz, 1978

PC-747 MODERN BEACH SAND, Punta Piedra, Bolivar, Colombia; R. D. Bray, 1981

PC-748 MODERN BEACH SAND, Mayaro, East Coast of Trinidad; Patrick Gooding, 1981

PC-749 MODERN BEACH SAND, Maracas, north coast of Trinidad; Patrick Gooding, 1981

PC-750 MODERN BEACH SAND, Praia Oceanica (Praia Joaquina), Ilha de Santa Catarina, Estado de Santa Catarina, Brazil; L. Martins, 1981

PC-751 MODERN RIVER SAND, Rio Itanhem, about 2.5 km away from the river mouth, at Alcobaca, Bahia, Brazil, x: 8,062,000.00; y: 478,500.00; Jesus de Oliviera, 1981

PC-752 MODERN RIVER SAND, Virgílio Garcia, Alcobaca, Bahia, Brazil, x: 8,063,424.00; y: 479,000,00 Jesus de Oliviera, 1981

PC-753 MODERN RIVER SAND, Rio Guamá near Ourem, Pará, Brazil. Lat. 1°32'50"S, Long. 47°06'29"W; A. Tancredi, 1981

PC-754 MODERN RIVER SAND, Rio Piriá at bridge over BR-316 near Preta Mina, Pará, Brazil. Lat. 1°43'38"S, Long. 46°35'40"W; A. Tancredi, 1981

PC-755 MODERN RIVER SAND, Rio Gurupi at bridge over BR-316, Pará, Brazil. Lat. 1°40'12"S; Long. 46°11'24"W; A. Tancredi, 1981

PC-756 MODERN BEACH SAND, Playa at Tongoy, Prov. Coquimbo, Chile; P. E. Potter, 1981 (one of two)

PC-757 MODERN BEACH SAND, Playa at Tongoy, Prov. Coquimbo, Chile; P. E. Potter, 1981 (two of two)

PC-758 MODERN BEACH SAND, Playa 3 km north of Rio Teniente and Pan American Hwy, Prov. Coquimbo, Chile; P. E. Potter, 1981

PC-759 MODERN BEACH SAND, Playa 3 km north of Taltal, Prov. Antofagasta, Chile; P. E. Potter, 1981

PC-760 MODERN BEACH SAND, Playa at Chañaral, Prov. Atacama, Chile; P. E. Potter, 1981 (one of two)

PC-761 MODERN BEACH SAND, Playa at Chañaral, Prov. Atacama, Chile; P. E. Potter, 1981 (two of two)

PC-762 MODERN BEACH SAND, Playa at Cobija, Prov. Antofagasta, Chile; P. E. Potter, 1981

PC-763 MODERN BEACH SAND, Playa near Farol Punta Corono (Caleta del Faro), Bahia de Ancud, Isla Chiloé, Chile; Lat. 41°47'15"S; Long. 73°53'30"W; E. Valenzuela, 1981

PC-764 MODERN BEACH SAND, Playa Mar Brava (Pacific side), Isla Chiloé, Chile, Lat. 41°55'30"S; Long. 74°0'W; E. Valenzuela, 1981

PC-765 MODERN BEACH SAND, Playa at Caldera, Prov. Atacama, Chile; P. E. Potter, 1981

PC-766 MODERN BEACH SAND, Playa at Huasco, Prov. Atacama, Chile; P. E. Potter, 1981 (one of two)

PC-766 MODERN BEACH SAND, Playa at Huasco, Prov. Atacama, Chile; P. E. Potter, 1981 (one of two)

PC-767 MODERN BEACH SAND, Playa at Huasco, Prov. Atacama, Chile; P. E. Potter, 1981 (two of two)

PC-768 MODERN BEACH SAND, unnamed playa about 20 km northwest of Antofagasta, and 11 km west of Hwy 1, Prov. Antofagasta, Chile; P. E. Potter, 1981

PC-769 MODERN BEACH SAND, Pichicuy, about 8 km south of Pichidangui, Prov. Aconcagua, Chile; P. E. Potter, 1981 (one of two)

PC-770 MODERN BEACH SAND, Pichicuy, about 8 km south of Pichidangui, Prov. Aconcagua, Chile; P. E. Potter, 1981 (two of two)

PC-771 MODERN BEACH SAND, Playa at Punta Arenas, Magallanes, Chile, Lat. 53.10°S, Long. 70.54°W; A Canon, ENAP, 1981

PC-772 MODERN BEACH SAND, Playa at Isla Lennox, Magallanes, Chile, Lat. 55.17.50°S; Long. 66.50.55°W; ENAP, 1981

PC-773 MODERN BEACH SAND, Playa at Pizarro, Isla Burnt, Península Hardy, Magallanes, Chile, Lat. 55.31.275S; Long. 66.01.10°W; ENAP, 1981

PC-774 MODERN RIVER SAND, Rio Preguica, Barreirinhas, Maranhão, Brazil; R. Marvin, 1981

PC-775 MODERN BEACH SAND, Playa at Puerto Saavedra, Prov. Cautin, Chile (PPS-320); J. Varela, 1981

PC-776 MODERN BEACH SAND, Playa about 15 km south of Río Maipo, Prov. Santiago, Chile, Long. 71°40'W; Lat. 33°40'S; J. Varela, 1981 (PSD-104)

PC-777 MODERN BEACH SAND, Playa about 5 km south of Punta la Vieja, near Reloca, Prov. Maule, Chile; J. Varela, 1981 (PCH-457)

PC-778 MODERN BEACH SAND, Playa at about 15 km north of Punta Nema and Quidico, Prov. Arauco, Chile; J. Varela, 1981 (PLL-149)

PC-779 MODERN BEACH SAND, Playa about 20 km southwest of Cañete, Prov. Arauco, Chile; J. Varela, 1981 (PR-212)

PC-780 MODERN BEACH SAND, Playa about 15 km north of Chanquiuque, Prov. Talca, Chile; J. Varela, 1981 (PLT-411)

PC-781 MODERN BEACH SAND, Playa about 5 km south of Pichilemu, Prov. Colchagua, Chile; J. Varela (PC-532)

PC-782 MODERN BEACH SAND, Playa about 8 km west of Putu, Prov. Maule, Chile; J. Varela, 1981 (PP-389)

PC-783 MODERN BEACH SAND, Playa about 3 km west of Chanco, Prov. Maule, Chile; J. Varela, 1981 (PP-435)

PC-784 MODERN BEACH SAND, Playa about 4 km west of Arauco, Prov. Arauco, Chile; J. Varela, 1981 (PR-207)

PC-785 MODERN BEACH SAND, Playa about 15 km west of Cañete, Prov. Arauco, Chile; J. Varela, 1981 (PR-207)

PC-786 MODERN BEACH SAND, El Choncho beach on delta of San Juan River, Depto. Chocó, Colombia. Sample No 2, collected by Ivan Correas, 1984

PC-787 MODERN BEACH SAND, beach at Charambira village on delta of San Juan River, Depto. Chocó, Colombia. Sample No. 3 collected by Ivan Correas, 1984

PC-788 MODERN BEACH SAND, beach at Charambira on delta of San Juan River, Depto. Chocó, Colombia. Sample No. 4 by Ivan Correas, 1984

PC-789 MODERN RIVER SAND, Río Maule and National Hwy 5, about 3 km north of San Javier, Prov. Linares, Chile; P. E. Potter, 1981

PC-790 MODERN RIVER SAND, Río Huasco at Vallenar, Prov. Atacama, Chile; P. E. Potter, 1981

PC-791 MODERN RIVER SAND, Río la Laja, Laja, Biobio, Chile; P. E. Potter, 1981

PC-792 MODERN RIVER SAND, Río Maipo and Hwy 5, about 3 km north of Buin, Prov. Santiago, Chile; P. E. Potter, 1981

PC-793 MODERN RIVER SAND, Río Copiapó at Copiapó, Prov. Atacama, Chile; P. E. Potter, 1981

PC-794 MODERN RIVER SAND, Río Choapa and hwy 5 at Pta. Huentelauquén, Prov. Coquimbo, Chile; P. E. Potter, 1981

PC-795 MODERN BEACH SAND, Playa between Hornitos and Michilla at km 94 of Hwy 1, Prov. Antofagasta, Chile; P. E. Potter, 1981

PC-796 MODERN RIVER SAND, Río Grande and Perú Hwy 1 at Río Grande, west of Palpa, Prov. Ica, Perú; P. E. Potter, 1981

PC-797 MODERN RIVER SAND, Río Reque and Hwy 1, Prov. Lambayeque, Perú; P. E. Potter, 1981

PC-798 MODERN RIVER SAND, Río Mala and Hwy 1, at San Antonio, Prov. Lima, Perú; P. E. Potter, 1981

PC-799 MODERN RIVER SAND, Río Huarmey and Hwy 1, about 6 km south of Huarmey, Prov. Ancash, Perú; P. E. Potter, 1981

PC-800 MODERN RIVER SAND, Río Carnaveli and Hwy 1, at km 749, Pecalorps, Prov. Arequipa, Perú; P. E. Potter, 1981

PC-801 MODERN RIVER SAND, Río Pisco and Hwy 1 near Pisco, Prov. Ica, Perú; P. E. Potter, 1981

PC-802 MODERN RIVER SAND, Río Chicama and Perú Hwy 1, Prov. Libertad, Perú; P. E. Potter, 1981

PC-803 MODERN BEACH SAND, Playa from Caleta La Misión, Tierra del Fuego, República Argentina. Lat. 53°42'36"S; Long. 67°49'58"W. Jean-Michel Fonck of Total, 1982

PC-804 MODERN BEACH SAND, Playa from Caleta La Misión, Tierra del Fuego, República Argentina. Long. 67°48'57"W; Lat. 53°42'36"S; Jean-Michel Fonck of Total, 1982

PC-805 MODERN BEACH SAND, Playa del Agua Dulce 8 km north of Río Choapa (near Huentelauquén), Prov. Coquimbo, Chile; R. Charrier, 1981

PC-806 MODERN BEACH SAND, Playa Cavancha, Iquique, Chile; J. Varela B., 1982

PC-807 MODERN BEACH SAND, Playa at Tonjupa, about 5 km north of Atacames, Prov. Esmeraldas, Ecuador; F. Maldonadao, 1981

PC-808 MODERN BEACH SAND, Playa at Rocafuerte about 10 km north of Río Verde, Prov. Esmeraldas, Ecuador; F. Maldonado, 1981

PC-809 MODERN BEACH SAND, Playa at Puerto Cabello, Carabobo, Venezuela; P. E. Potter, 1982

PC-810 MODERN BEACH SAND, Playa 5 km west of El Manglar, Distrito Zandra, Falcon, Venezuela; P. E. Potter, 1982

PC-811 MODERN BEACH SAND, Playa 10 km east of Cojoro, Guajira, Distrito Paez, Zulia, Venezuela; P. E. Potter, 1981 (one of two)

PC-812 MODERN BEACH SAND, Playa 10 km east of Cojoro, Guajira, Distrito Paz, Venezuela; P. E. Potter, 1982 (two of two)

PC-813 MODERN RIVER SAND, Río Sabaneta y Hwy 3, Distrito Miranda, Falcon, Venezuela; P. E. Potter, 1982

PC-814 MODERN BEACH SAND, Playa at San Rafael (El Mojan), Distrito Mara, Venezuela; P. E. Potter, 1982

PC-815 MODERN RIVER SAND, Río Tocuyo y Hwy 3, Yaracal, Distrito Silva, Falcon, Venezuela; P. E. Potter, 1982

PC-816 MODERN BEACH SAND, Playa at Boca Paijana, east of Sinamaica, Distrito Paez, Zulia, Venezuela; P. E. Potter, 1982

PC-817 MODERN RIVER SAND, mouth of Río Biobío near Concepcion, Prov. Bio Bio, Chile; Ruben Martinez, 1981

PC-818 MODERN BEACH SAND, Playa at El Supi about 8 km north of Adicora, Peninsula de Paraguana, Falcon, Venezuela; P. E. Potter, 1982

PC-819 MODERN BEACH SAND, Playa about 5 km west of Barcelona, Distrito Bolivar, Anzoategui, Venezuela; P. E. Potter, 1982

PC-820 MODERN BEACH SAND, Playa at Miramar, 6 km north of Capatarida, Distrito Buchivaco, Falcon, Venezuela; P. E. Potter, 1982

PC-821 MODERN RIVER SAND, Río Agua Viva and Hwy 3 about 8 km east of Dabajuro, Distrito Buchivaco, Falcon, Venezuela; P. E. Potter, 1982

PC-822 MODERN BEACH SAND, Playa at Irapa, Distrito Marino, Sucre, Venezuela; P. E. Potter, 1982

PC-823 MODERN RIVER SAND, Río Tuy and Hwy 9, Distrito Acevedo, Miranda, Venezuela; P. E. Potter. 1982

PC-824 MODERN BEACH SAND, Playa at Río Seco, Distrito Miranda, Falcon, Venezuela; P. E. Potter, 1982 (one of two)

PC-825 MODERN BEACH SAND, Playa at Río Seco, Distrito Miranda, Falcon, Venezuela; P. E. Potter, 1982 (two of two)

PC-826 MODERN BEACH SAND, Playa 3 km west of San Juan de los Cayos, Distrito Acosta, Falcon, Venezuela; P. E. Potter, 1982 (one of two)

PC-828 MODERN BEACH SAND, Playa northeast of Guiria, Distrito Valdez, Sucre, Venezuela; P. E. Potter, 1982 (one of one)

PC-829 MODERN BEACH SAND, Playa at Saucedo, Distrito Ribero, Sucre, Venezuela; P. E. Potter, 1982

PC-830 MODERN BEACH SAND, Playa at Machurucuto, Distrito Paez, Miranda, Venezuela; P. E. Potter, 1982

PC-831 MODERN BEACH SAND, Playa at Río Caribe, Distrito Arismendi, Sucre, Venezuela; P. E. Potter, 1982

PC-832 MODERN RIVER SAND, Río Maribela at San Antonio and Hwy 9 at Km 653, Distrito Valdez, Sucre, Venezuela; P. E. Potter, 1982

PC-833 MODERN BEACH SAND, Playa de San Luis about 8 km west of Cumana, Distrito Sucre, Sucre, Venezuela; P. E. Potter, 1982 (one of two)

PC-834 MODERN BEACH SAND, Playa de San Luis about 8 km west of Cumana, Distrito Sucre, Sucre, Venezuela; P. E. Potter, 1982 (one of two)

PC-835 MODERN BEACH SAND, Arrojo, Guarapana, Guajira, Distrito Paez, Zulia, Venezuela; P. E. Potter. 1982

PC-836 MODERN BEACH SAND, Playa 3 km northeast Guiria, Distrito Valdez, Venezuela; P. E. Potter, 1982 (two of two)

PC-837 MODERN RIVER SAND, Río Ñuble and Hwy 5 at Cocharcas, Prov. Ñuble, Chile; P. E. Potter, 1981

PC-838 MODERN RIVER SAND, Río Los Choros and Hwy 5 at km 554, Prov. Coquimbo, Chile; P. E. Potter, 1981

PC-839 MODERN RIVER SAND, Río Lontué and Hwy 5, Prov. Curoco, Chile; P. E. Potter, 1981

PC-840 MODERN RIVER SAND, Río Longaví and Hwy 5, Prov. Linares, Chile; P. E. Potter, 1982

PC-841 MODERN RIVER SAND, Río Lebu at mouth, Lebu, Prov. Arauco, Chile; P. E. Potter, 1982

PC-842 MODERN RIVER SAND, Río Perquilauquén, Prov. Linares, Chile; P. E. Potter, 1981

PC-843 MODERN RIVER SAND, Río Limarí and Hwy 5, Prov. Coquimbo, Chile; P. E. Potter, 1981

PC-844 MODERN RIVER SAND, Río Aconcagua and Hwy 5 west of Llay-Llay, Prov. Valparaiso, Chile; P. E. Potter, 1982

PC-845 MODERN BEACH SAND, Playa at Sagua east of Paraguiapoa, Distrito Paez, Zulia, Venezuela; P. E. Potter, 1982

PC-846 MODERN BEACH SAND, Playa at Río Verde, Prov. Esmeraldas, Ecuador; F. Maldonado, 1981

PC-847 MODERN BEACH SAND, Playa at Atacames, Prov. Esmeraldas, Ecuador; F. Maldonado, 1981

PC-848 MODERN RIVER SAND, Río Paraíba, Tremembé, São Paulo, Brazil; Nelson da Silva, 1976

PC-849 MODERN BEACH SAND, shell beach at Nickerie, Suriname; N98234, E16469; Sample I of P. Augustinus, 1982

PC-850 MODERN BEACH SAND, Bucklebury, Suriname; N97729, E21211; Sample H of P. Augustinus, 1982

PC-851 MODERN BEACH SAND, Matapicca, Suriname; N98216, E39082; Sample F of P. Augustinus, 1982

PC-852 MODERN BEACH SAND, Pruimeboom, Sheet 8d (1:40,000), N96200, E48487, Suriname: Sample A from Augustinus, 1982

PC-853 MODERN BEACH SAND, Praia do Picanco, Município de Braganca, Pará, Brazil. Long. 46°46'00"W; Lat. 00°48'38"S; Tancredi, 1982

PC-854 MODERN RIVER SAND, Río Piura, Piura, Prov. Piura, Perú; P. E. Potter, 1981

PC-855 MODERN RIVER SAND, Río Cañete y Perú 1, near San Vicente de Cañete, Prov. Lima, Perú; P. E. Potter, 1981

PC-856 MODERN RIVER SAND, Río Yauca y Perú 1, Prov. Arequipa, Perú; P. E. Potter, 1981

PC-857 MODERN RIVER SAND, Río Chira at Sullana, Prov. Piura, Perú; P. E. Potter, 1981

PC-858 MODERN BEACH SAND, Playa Cavancha Iquique, Prov. Tarapacá, Chile; J. Varela, 1982

PC-859 MODERN BEACH SAND, Beagle Channel, Puerto Williams, Navarino Island, Prov. Magallanes, Chile; M. Suarez, 1982

Fraction analysis of MODERN BEACH SAND, Natal, Rio Grande de Norte, Brazil

PC-860 Fraction analysis (PC-681, 0.707-1.0)

PC-861 Fraction analysis (PC-681, 0.5-0.707)

PC-862 Fraction analysis (PC-681, 0.354-0.51)

PC-863 Fraction analysis (PC-680, 0.250-0.354)

PC-864 Fraction analysis (PC-680, 0.177-0.250)

PC-865 Fraction analysis (PC-680, 0.88-0.125 and PC-682, 0.88-0.125)

PC-866 Fraction analysis (PC-680, 0.88-0.125 and PC-682, 0.88-0.125)

PC-867 Fraction analysis (PC-680, 0.62-0.88 and PC-682, 0.62-0.88)

Fraction analysis of MODERN BEACH SAND, Huacho, Prov. de Lima, Peru

PC-868 Fraction analysis (PC-734, 0.707-1.0)

PC-869 Fraction analysis (PC-734, 0.5-0.707)

PC-870 Fraction analysis (PC-734, 0.354-0.5)

PC-871 Fraction analysis (PC-734, 0.250-0.354)

PC-872 Fraction analysis (PC-734, 0.177-.025)

PC-873 Fraction analysis (PC-734, 0.125-0.177)

PC-874 Fraction analysis (PC-734, 088-0.125)

PC-875 Fraction analysis (PC-734, 0.62-0.88 and PC-732, 0.62-0.88)

PC-876 MODERN RIVER SAND, Rio Parnaíba at Fazenda Lagoa Vermelha, Brejo do Moingueiro, Estado do Maranhão, Brazil; Elena Franzinelli, 1982

PC-877 MODERN RIVER SAND, Playa de Medio, Bahía de Sanquinga, near Quitasol, Departamento de Nariño, Colombia; Ingeominas, 1983 (one of two)

PC-878 MODERN RIVER SAND, Playa at Bajo El Cauchal, Parque Nacional Sanquianga, near Quitasol, Dept. Nariño, Colombia (one of two); Ingeominas, 1983

PC-879 MODERN RIVER SAND, Tidal inlet at Estero Las Islas, Parque Nacional Sanquianga, Dept. Nariño, Colombia; Ingeominas, 1983

PC-880 MODERN RIVER SAND, Rio Coello near Gualandy, Tolima, Colombia (x: 898,000: y: 960,000); Ingeominas, 1983

PC-881 MODERN RIVER SAND, Rio Dagua at Zaragoza, about 24 km east of Buena Ventura, Depto. Valle del Cauca, Colombia. Sample No. 1 of Ivan Correas, 1984

PC-882 MODERN RIVER SAND, Río Guatiquia at Villaviencio, Meta, Colombia; P. E. Potter, 1983

PC-883 MODERN RIVER SAND, Río Guayuriba, about 18 km west of Villaviencio, Meta, Colombia; P. E. Potter, 1983

PC-884 MODERN RIVER SAND, Rio Araguaia at Santa Helena, 110 km west of Araguaina, Goiás, Brazil (Lat. 7°19'29"S, Long. 49°13'25"W); Robert Korpershoek, 1982

PC-885 MODERN BEACH SAND, Praia da Barra, Rio de Janeiro, Rio de Janeiro, Brazil; P. E. Potter

PC-886 MODERN BEACH SAND, Fortaleza, Ceará, Brazil; P. E. Potter, 1974

PC-887 MODERN RIVER SAND, Rio Paraquai, Bahia de Assuncao, Assuncao, Paraquay

PC-888 MODERN BEACH SAND, Laguna de Agua Blanca, Isla de Margarita, Venezuela; R. Bray, 1982 (See Muñoz, 1972, Fig. 1)

PC-889 MODERN BEACH SAND, Laguna de Agua Blanca, Isla de Margarita, Venezuela; R. Bray, 1982 (See Muñoz, 1972, Fig. 1)

PC-890 MODERN BEACH SAND, Punta Velero, Atlántico, Colombia; R. Bray, 1982 (See Muñoz, 1972, Fig. 2)

PC-891 MODERN BEACH SAND, Punta Moreno, Isla de Margarita, Venezuela; R. Bray, 1982

PC-892 MODERN BEACH SAND, Punta Canoas, Bolivar, Colombia; R. Bray, 1982

PC-893 MODERN BEACH SAND, Punta Mosquito, Isla de Margarita, Venezuela; R. Bray, 1982 (See Muñoz, 1972, Fig. 1 for location)

PC-894 MODERN RIVER SAND, Bajo El Cauchai, Parque Nacional de Sanquianga, near Quitasol, Nariño, Colombia; Ingeominas, 1983 (two of two, see PC-878)

PC-895 MODERN BEACH SAND, Playa del Medio, Parque Nacional Sanquianga, near Quitasol, Nariño, Colombia; Ingeominas, 1983 (two of two - see PC-877)

PC-896 MODERN BEACH SAND, Playa Bahia; Parque Nacional Sanquianga, near Quitasol, Nariño, Colombia; Ingeominas, 1982

PC-897 MODERN RIVER SAND, Río Magdalena at railroad bridge at Giradot, Cundinamarca, Colombia; Ingeominas, 1983

PC-898 MODERN RIVER SAND, Río Recio (tributary to Magdalena near La Sierra) (x: 905,000; y: 921,000), Tolima, Colombia; Ingeominas, 1983

PC-899 MODERN RIVER SAND, Playa at Riohacha, La Guajira, Colombia; P. E. Potter, 1983 (one of two)

PC-900 MODERN BEACH SAND, Playa at Riohacha, La Guajira, Colombia; P. E. Potter, 1983

PC-901 MODERN RIVER SAND, Río Rancheria and the Riohacha-Maicao Road, 7 km southeast of Riohacha, La Guajira, Colombia; P. E. Potter, 1983

PC-902 MODERN RIVER SAND, Río Fundación and the Santa Marta-Bucaramanga Road at Fundación, Magdalena, Colombia; P. E. Potter, 1983

PC-903 MODERN RIVER SAND, Río Aracataca at Aracataca on the Santa Marta-Bucaramanga Road, Magdalena, Colombia; P. E. Potter, 1983

PC-904 MODERN RIVER SAND, Río Sevilla on the Santa Marta-Bucaramanga Road, Magdalena, Colombia; P. E. Potter, 1983

PC-905 MODERN RIVER SAND, Río Ancho on Río Ancho on the Santa Marta-Riohacha Road, La Guajira, Colombia; P. E. Potter, 1983

PC-906 MODERN RIVER SAND, Río Don Diego on the Santa Marta-Riohacha Road, Magdalena, Colombia; P. E. Potter, 1983

PC-907 MODERN RIVER SAND, Río Piedras about 25 km east of Santa Marta on the Santa Marta-Riohacha road, Colombia; P. E. Potter, 1983

PC-908 MODERN BEACH SAND, Playa at Parque Nacional Tayrona about 20 km east of Santa Marta, Magdalena, Colombia; P. E. Potter, 1983 (one of two - see PC-913)

PC-909 MODERN BEACH SAND, Playa at Pueblo Viejo on the Barranquilla-Cienaga Road, Magdalena, Colombia; P. E. Potter (one of two - see PC-914)

PC-910 MODERN BEACH SAND, Playa at Salgar west of Barranquilla, Magdalena, Colombia; P. E. Potter, 1983

PC-911 MODERN BEACH SAND, Playa at Covenas, Cordoba, Colombia; Hermann Duque-Caro, 1982

PC-912 MODERN BEACH SAND, Playa at Punta Escondido, Cordoba, Colombia; Hermann Duque-Caro, 1982

PC-913 MODERN BEACH SAND, Playa at Parque Nacional Tayrona, about 20 km east of Santa Marta, Magdalena, Colombia; P. E. Potter, 1983 (two of two - see PC-908)

PC-914 MODERN BEACH SAND, Puerto Viejo on the Barranquilla-Cienaga Road, Magdalena, Colombia; P. E. Potter, 1983 (two of two -see also PC-909)

PC-915 MODERN RIVER SAND, Río Tapias at Puente Bombas on the Riohacha - Santa Marta Road, La Guajira, Colombia; P. E. Potter, 1983

PC-916 MODERN BEACH SAND, Playa 3 km northeast of Arroyo de Piedra about 25 km northeast of Cartagena, Bolivar, Colombia; P. E. Potter, 1983 (one of two - see PC-917)

PC-917 MODERN BEACH SAND, 3 km northeastof Arroyo de Piedra about 25 km mortheast of Cartagena, Bolivar, Colombia; P. E. Potter, 1983 (two of two - see PC-917)

PC-918 MODERN RIVER SAND, Río Smaca at bridge on the road Villa de Leyia-Sachica, 5.7 km south of villa de Leyia, Boyacá, Colombia; P. E. Potter, 1983

PC-919 MODERN BEACH SAND, Pointe isre, east of Les hattes, Long. 55°52'58"W; Lat. 5°64'52"N, French Guiana; Elena Franzinelli, 1983

PC-920 MODERN BEACH SAND, East of Les hattes, Long. 53°48'W; Lat. 5°43'N, French Guiana; Elena Franzinelli, 1983 (one of two)

PC-921 MODERN BEACH SAND, near Les hattes, Long. 53°53'10"W; Lat. 5°45'24"N, French Guiana; Elena Franzinelli, 1982 (two of two)

PC-922 MODERN BEACH SAND, Praia de Les hattes (bank of Flueve Maroni) at Les hattes, Long. 53°56'13"W; Lat. 5°44'19"N, French Guiana; Elena Franzinelli, 1983

PC-923 MODERN BEACH SAND, Praia das Pontas das Rochas, Kouru, about 60 km northwest of Cayenne, Long. 53°21'54"W; Lat. 5°9'50"N, French Guiana; Elena Franzinelli, 1983

PC-924 MARINE BOTTOM SAMPLE, (Hll of Siegal), Chilean Archipelago; F. R. Siegal, 1983

PC-925 MODERN BEACH SAND, beach sand from just outside of Bahía de Portete, La Guajira, Colombia; Mr. Parker, 1983

PC-926 MODERN BEACH SAND, beach sand from inside bay near future coal pier, Bahía de Portete, east of Rio Hacha, La Guajira, Colombia; Mr. Parker, 1983

Fraction Analysis of Rio Guatiquia at Villavicencio, Meta, Colombia, PC-882

PC-927 Fraction analysis (PC-882, 1.0 - 0.707)

PC-928 Fraction analysis (PC-882, 0.79 - 0.5)

PC-929 Fraction analysis (PC-882, 0.5 - 0.35)

PC-930 Fraction analysis (PC-882, 0.25 - 0.350)

PC-931 Fraction analysis (PC-882, 0.177 - 0.250)

PC-932 Fraction analysis (PC-882, 0.125 - 0.17)

PC-933 Fraction analysis (PC-882, 0.088 - 0.125)

PC-934 Fraction analysis (PC-882, 0.062 - 0.083)

Fraction Analysis of Orinoco River in Venezuela

PC-935 (PC-336, 0.5 - 0.70)

PC-936 (PC-336, 0.35 - 0.50)

PC-937 (PC-336, 0.25 - 0.35)

PC-938 (PC-336, 0.177 - .025)

PC-939 (PC-336, 0.125 - 0.177)

PC-940 (PC-336, 0.088 - 0.125

PC-941 (PC-336, 0.062 - 0.088)

PC-942 (PC-336, 0.7 - 1.0)

PC-943 MODERN RIVER SAND, Rio Cravo about 50 km east of Sogamoso, Boyaca Prov., Colombia; Lat. 5°21.5' N; Long. 72°24' W; R. Vargas, 1983 - Riverbank sample during rainy season. Headwater stream of Orinoco. Same as PC-944.

PC-944 MODERN RIVER SAND, Rio Cravo about 50 km east of Sogamoso, Boyaca Prov., Colombia; Lat. 5°21.5' N; Long. 72°24' W; R. Vargas, 1983 - river bank sample during rainy season. Headwater stream of Orinoco. Same as PC-943.

PC-945 MODERN BEACH SAND, Playa El Amejal near El Valle Solano, Dept. Chocó, Colombia; A. Fabre, 1983. Same as PC-1039.

PC-946 MODERN BEACH SAND, Playa al norte de Puerto Mutis, on Bahia Solano, Depto. Chocó, Colombia; A. Fabre, 1983. Same as PC-1035.

PC-947 MODERN RIVER SAND, Rio São Francisco, below bridge at Propriá, Sergipe, Brazil; Antonio Sergio, 1977. Same as PC-459.

PC-948 MODERN BEACH SAND, Playa al norte de Puerto Mutis, on Bahia Solano, Depto. Chocó, Colombia; A. Fabre, 1983

PC-949 MODERN BEACH SAND, from foreshore Jacarepaguá, west of Rio de Janeiro, R. J. Brazil; Petrobras, 1978. Praia marinha de plataforma rasa - Sub. 295. Same as PC-990.

PC-950 MODERN BEACH SAND, from lagoon Jacarepaguá, west of Rio de Janeiro, R. J. Brazil; Petrobras sample 1697-12a, 1978

PC-951 MODERN SAND, from foreshore Jacarepaguá, west of Rio de Janeiro, R. J. Brazil; Petrobras sample sub-293-3, Praias marinhas de plataforma rasa

PC-952 MODERN SAND, from Jacarepaguá, west of Rio de Janeiro, R. J. Brazil; Petrobras sample sub-299 - Areias de plataforma rasa

PC-953 MODERN SAND, from Jacarepaguá, west from Rio de Janeiro, R. J. Brazil; Petrobras sample 1699-14, Areias de fundo de enseñada

PC-954 MODERN BEACH SAND, San Vicente, Manabi Province, Ecuador, 0°38'S. Lat.; 80°25W. Long.; F. Maldonado, 1982

PC-955 MODERN RIVER SAND, Rio Paraguay, Passo Tucum, Caceres, Mato Grosso do Sul, Brazil; P. E. Potter, 1977

PC-956 MODERN RIVER SAND, Rio Paraguai, Porto Itaí near Corumbá, Mato Grosso do Sul, Brazil; P. E. Potter, 1977

PC-957 MODERN RIVER SAND, Rio Pirapucu, Bela Vista, Mato Grosso, Brazil

PC-958 MODERN BEACH SAND along Hwy 1 about 15 km south of Tocopilla, Prov. Antofagasto, Chile; P. E. Potter, 1981

PC-959 MODERN RIVER SAND, Rio Sechin about 5 km from Casma, Prov. Ancash, Peru; P. E. Potter, 1981

PC-960 MODERN RIVER SAND, Rio Santa and Hwy 1, Prov. Libertad, Peru; P. E. Potter, 1981

PC-961 MODERN RIVER SAND, Rio Elqui and Hwy 5, La Serrena, Prov. Coquimbo, Chile; P. E. Potter, 1981

PC-962 MODERN BEACH SAND, mouth of Rio Orpúa, Depto. Chocó, Colombia. Sample No. 5 of Ivan Correas, 1984

PC-963 MODERN BEACH SAND, Sibiru on delta of San Juan River, Depto. Chocó, Colombia. Sample No. 6 of Ivan Correas, 1984

PC-964 MODERN BEACH SAND, Pizerro near mouth of Baudó River, Depto. Chocó, Colombia. Sample No. 8 of Ivan Correas, 1984 (one of one)

PC-965 MODERN BEACH SAND, north of Pizarro, at mouth of Baudó River, Depto. Chocó, Colombia. Sample No. 7 of Ivan Correas, 1984

PC-966 MODERN RIVER SAND, Rio Baudó at Pizarro, Depto. Chocó, Colombia. Sample No. 9 of Ivan Correas, 1984

PC-968 MODERN BEACH SAND, Praia do Farol de São Tomé, Campos Delta, Municipio de Campos, Estado do Rio de Janeiro, Brazil. Nestor da Silvá, 1978

PC-969 MODERN BEACH SAND, Praia do Medo Barra de Guaratiba, Estado do Rio de Janeiro, Brazil. Nestor da Silvá, 1978.

PC-970 MODERN RIVER SAND, Rio Vermehlo at Goias, Estado de Goias, Brazil. P. E. Potter, 1984

PC-971 MODERN BEACH SAND near Charanvira, northwest of Garcia Gomez on delta of San Juan River, Dept. Chocó, Colombia. Sample 4 of Ivan Correas, 1984 Same as PC-788.

PC-972 MODERN BEACH SAND near Charanvira, northwest of Garcia Gomez on delta of San Juan River, Dept. Chocó, Colombia. Sample No. 3 of Ivan Correas, 1984

PC-973 MODERN BEACH SAND, El Choucho, near Boca San Juan, southwest of Garcia Gomez of Delta of San Juan River, Dept. of Chocó, Colombia. Sample No. 2 of Ivan Correas, 1984. Same as PC-786.

PC-974 MODERN RIVER SAND, Rio Dagua at Zaraoza and east of Cordoba on the Buenaventura-California Hwy, Dept. Cauca, Colombia. Sample No. 1 of Ivan Correas, 1984

PC-975 MODERN BEACH SAND, at Boca Orpua near Orpua, Dept. of Chocó, Colombia. Sample No. 5 of Ivan Correas, 1984

PC-976 MODERN RIVER SAND, Riacho Campo Bezo proximo do Lago Azul, Agulhas Negras, Parque Estavdual das Aqulhas Negras, Estado do Rio de Janeiro, Brazil.

PC-977 MODERN RIVER SAND, Rio Paraná, near Santa Fe, (600 km above mouth) Province de Santa Fe, Argentina, South America. Oxbow sample from river floodplain. See location map, see also PC-354, 355.

PC-978 MODERN RIVER SAND, Rio Camaquã, about 30 km west at Camaquã, on BR116, Estado de Rio Grande do Sul, Brazil. P. E. Potter, 1976. See also PC-979.

PC-979 MODERN RIVER SAND, Small stream, Limite de Municipio between Pedro Osório and Pelotas, Estado de Rio Grande do Sul, Brazil, P. E. Potter, 1976. See also PC-978.

PC-980 MODERN RIVER SAND, Rio Huacho, about 3 km east of Peru 1 and Huacho, Prov. de Lima, Peru. P. E. Potter, 1981. See SH_____ in shale collection.

PC-981 MODERN BEACH SAND, Praia about 20 km southeast at Cassino near Rio Grande, Estado de Rio Grande do Sul, Brazil. P. E. Potter, 1975. See also PC-669, PC-684 and PC-982.

PC-982 MODERN BEACH SAND, Praia de Olho d'Agua, Municipio de São Luis, Estado de Maranhão, Brazil.

PC-983 MODERN BEACH SAND, Praia de Aracao, Municipio de São Luis, Estado de Maranhão, Brazil.

PC-984 MODERN BEACH SAND, Praia Porto Negra, Municipio de São Luiz, Estado de Maranhão, Brazil. Oswaldo of Petrobras, 1981.

PC-985 MODERN BEACH SAND, Praia Queimada, Povoado-Curimatá, Municipio Provoado Cruz, Maranhão, Brazil. Oswaldo of Petrobras, 1981.

PC-986 to PC-1032
The samples below are from Jacarepaguá, west of Rio de Janeiro, R. J., Brazil and were donated by Ceasar de Pedro of PETROBRAS, March 29, 1984

PC-986 (Sub-181) Areia marinhas de platforma rasa, map square 668, 7449

PC-987 (Sub-301) Areia marinhas de platforma rasa, map square 668, 7451

PC-988 (Sub-299) Areia marinhas de platforma rasa, map square 668, 7451

PC-989 (Sub-297) Areia marinhas de platforma rasa, map square 668, 7451

PC-990 (Sub-295) Areia marinhas de platforma rasa, map square 668, 7452

PC-991 (Sub-293) Areia marinhas de platforma rasa, map square 668, 7452

PC-992 (Sub-289) Areia marinhas de platforma rasa, map square 668, 7453

PC-993 (Sub-287) Areia marinhas de platforma rasa, map square 668, 7453

PC-994 (Sub-284) Areia marinhas de platforma rasa, map square 668, 7454.

PC-995 (1681-17) Restinga interna, map square 671, 7455

PC-996 (1681-19) Restinga interna, map square 671, 7455

PC-997 (1679-15) Restinga interna, map square 668, 7455

PC-998 (1697-48) Areia de fundo de enseado, map square 667, 7457

PC-999 (1677-21a) Areia de fundo de enseado, map square 666, 9456

PC-1001 (1677-6) Restinga interna, map square 664, 7455

PC-1002 (1677-8) Restinga externa, map square 664, 7454

PC-1003 (1675-12) Restinga interna, map square 661, 7455

PC-1004 (S-219a) Restinga externa, map square 660, 7453

PC-1005 (1673-16) Restinga interna, map square 659, 7454

PC-1006 (S-2-182b) Areia de fundo de enseado, map square 659, 7455

PC-1007 (1523-1) Restinga interna, map square 658, 7453

PC-1008 (1523-2) Restinga externa, map square 657, 7454

PC-1009 (1525-27) Restinga interna, map square 656, 7452

PC-1010 (1525-26) Cordoẽs litorãneos paralelos, map square 656, 7432

PC-1011 (1525-25) Cordoẽs litorãneos paralelos, map square 655, 7452

PC-1012 (1525-23) Cordoẽs litorãneos paralelos, map square 654, 7451

PC-1013 (1525-4) Restinga interna, map square 655, 7453

PC-1014 (1527-18-2a) Cordoẽs de praia de enseado, map square 652, 7453

PC-1015 (1669-17-1213) Cordoes de praia de enseado, map square 652, 7453

PC-1016 (1671-7) Legue aluvial, map square 654, 7456

PC-1017 (1705-5e) Complexo fluvial, areias de canal, map square 654, 7459

PC-1018 (1701-13-2a) Cordões de praia de enseado, map square 661, 7457

PC-1019 (1699-15b) Legue aluvial, map square 662, 7459

PC-1020 (1699-9) Cordões de praia de enseado, map square 664, 7459

PC-1021 (1699-14) Areia de fundo de enseado, map square 664, 7459

PC-1022 (1697-12a) Areia de fundo de enseado, map square 666, 7458

PC-1023 (1699-21-2b) Cordões de praia de enseado, map square 664, 7459

PC-1024 (1719-1b) Remanescentes de sedimentos Pliocẽnicos, map square 665, 7460

PC-1025 (1719-13) Remanescentes de sedimentos Pliocênicos, map square 666, 7460

PC-1026 (1719-14) Remanescentes de sedimentos Pliocênicos, map square 666, 7460

PC-1027 (1719-11) Legue aluvial, map square 667, 7460

PC-1028 (1719-19) Camadas de areias pretas, map square 666, 7460

PC-1029 (1719-9a) Complexo fluvial areias de canal, map square 667, 7462

PC-1030 (1719-23) Camadas de areias pretas, map square 666, 7462

PC-1031 (1719-21) Camadas de areias pretas, map square 666, 7462

PC-1032 (1721-7e) Complexo fluvial areias de canal, map square 664, 7462

PC-1033 MODERN BEACH SAND, Praia de Grussai, Campos Delta, Rio de Janeiro, Brazil; Nestor da Silva, 1979

PC-1034 MODERN BEACH SAND, (light minerals only). Playa El Amejal near Bahia Solano, Dept. Chocó, Colombia; Andre Fabre, 1983. Same as 945.

PC-1035 MODERN BEACH SAND, (light minerals only). Playa al sur de Puerto Mutis y al norte El Valle, Dept. Chocó, Colombia; Andre Fabre, 1983. Same as 946.

PC-1036 MODERN BEACH SAND, in front of sea wall on the Georgetown-Kittytown line bear the Kitty bandstand, Guyana; Long. 58°8'W; Lat. 6°, 50'N; Steven Small and Allan Gibbs, 1984

APPENDIX II PETROGRAPHIC DATA OF SOUTH AMERICAN BEACH AND RIVER SANDS

PROVINCE	SAMPLE	Qt	Qu	Qc	Ft	Fk	Fp	Fk/Ft	RFt	P	M	V	Ar	Ca	Sa	Si	A	C	M	HM
6	PC-229R	97	93	4	1	1	0	1.000	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6	PC-296R	45	35	10	7	3	4	0.429	35	1	11	74	1	0	4	9	0	4	1	8
6	PC-336R	92	84	8	1	1	0	1.000	6	2	31	0	14	0	35	12	6	0	0	1
6	PC-337R	86	83	3	1	1	0	1.000	10	0	9	0	24	0	19	41	7	1	1	1
1	PC-339B	97	95	2	0	0	0	*****	1	0	0	0	0	0	50	50	0	0	1	1
1	PC-340B	95	93	2	1	1	0	1.000	1	0	0	0	0	0	0	0	100	0	0	3
1	PC-341B	96	95	1	1	1	0	1.000	0	0	0	0	0	0	0	0	0	0	0	3
1	PC-342B	98	96	2	1	1	0	1.000	0	0	0	0	0	0	0	0	0	0	0	1
1	PC-343B	95	93	2	3	1	2	0.333	1	0	0	0	0	0	0	0	0	0	0	1
1	PC-344B	97	96	1	1	1	0	1.000	0	0	0	0	0	0	0	0	0	0	0	2
6	PC-345R	94	93	1	4	3	1	0.750	1	0	0	0	0	0	0	0	0	0	0	1
6	PC-346R	99	96	3	1	1	0	1.000	0	0	0	0	0	0	0	0	0	0	0	0
6	PC-347R	97	95	2	2	2	0	1.000	1	0	0	0	0	0	0	0	0	0	0	0
6	PC-348R	96	94	2	2	2	0	1.000	1	0	0	0	0	0	0	0	0	0	1	0
6	PC-349R	94	90	4	4	3	1	0.750	1	43	0	0	0	NA	29	21	7	0	0	1
6	PC-350R	95	92	3	2	2	0	1.000	2	6	18	0	29	0	18	5	24	0	0	1
6	PC-351R	97	91	6	1	1	0	1.000	1	0	0	0	0	0	0	0	0	0	1	0
6	PC-352R	99	96	3	0	0	0	*****	0	0	0	0	0	0	0	0	0	0	0	1
6	PC-354R	97	95	2	1	1	0	1.000	1	7	39	3	12	12	6	12	9	0	0	1
6	PC-355R	97	94	3	3	2	1	0.667	0	0	0	0	0	0	0	0	0	0	0	0
1	PC-358B	78	77	1	17	11	6	0.647	3	NA	NA	NA	NA	NA	NA	NA	NA	0	0	2
1	PC-359B	80	79	1	10	8	2	0.800	5	44	31	0	0	0	0	0	25	0	0	5
1	PC-360B	83	80	3	8	4	4	0.500	2	23	7	0	0	8	8	8	46	0	0	7
1	PC-361B	95	95	0	2	2	0	1.000	3	7	0	0	0	71	0	8	14	0	0	0
1	PC-366B	99	98	1	0	0	0	*****	1	0	0	0	0	0	0	100	0	0	0	0
6	PC-367R	90	89	1	8	8	0	1.000	2	88	6	0	0	0	6	0	0	0	0	0
6	PC-368R	80	77	3	13	9	4	0.692	1	87	0	0	0	0	0	0	13	0	2	4
6	PC-369R	77	72	5	17	14	3	0.824	4	47	0	0	0	0	20	13	20	0	1	1
6	PC-370R	83	76	7	14	10	4	0.714	1	82	0	0	0	0	0	0	18	0	1	1
1	PC-373B	99	97	2	0	0	0	*****	0	0	0	0	0	0	0	0	0	0	0	1
1	PC-513B	96	94	2	1	1	0	1.000	3	0	0	0	0	0	0	0	100	0	0	0
6	PC-540R	98	94	4	1	1	0	1.000	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
6	PC-546R	98	96	2	0	0	0	*****	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	2
6	PC-547R	88	83	5	1	1	0	1.000	3	NA	NA	NA	NA	NA	NA	NA	NA	0	0	8
5	PC-548B	90	76	14	2	1	1	0.500	5	6	70	0	0	22	0	0	2	0	0	3
1	PC-549R	95	89	6	3	2	1	0.667	2	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
6	PC-579R	60	44	16	2	1	1	0.500	24	8	85	2	0	0	5	0	0	11	0	3
2	PC-625B	30	28	2	21	4	17	0.190	41	1	0	95	0	1	2	1	0	1	0	7
2	PC-626B	23	19	4	26	4	22	0.154	45	0	1	95	0	2	2	0	0	1	0	5
2	PC-627B	11	4	7	0	0	0	*****	79	0	74	6	16	0	2	2	0	10	0	0
2	PC-628B	13	3	10	0	0	0	*****	86	0	5	94	0	0	1	0	0	1	0	0
6	PC-629R	13	12	1	14	1	13	0.071	64	0	0	100	0	0	0	0	0	0	1	8
2	PC-630B	51	45	6	11	6	5	0.545	30	4	12	81	0	0	1	2	0	4	0	4
2	PC-631B	31	27	4	7	3	4	0.429	58	2	13	74	0	9	0	2	0	3	0	1
1	PC-632B	92	92	0	0	0	0	*****	8	0	0	0	0	100	0	0	0	0	0	0
1	PC-633B	30	30	0	0	0	0	*****	0	0	0	0	0	0	NA	0	0	0	0	70

APPENDIX III PETROGRAPHIC DATA OF SOUTH AMERICAN BEACH AND RIVER SANDS

PROVINCE	SAMPLE	Qt	Qu	Qc	Ft	Fk	Fp	Fk/Ft	RFt	P	M	V	Ar	Ca	Sa	Si	A	C	M	HM
6	PC-634R	19	12	7	15	1	14	0.067	63	0	3	96	0	0	0	1	0	1	0	2
6	PC-635aR	23	19	4	19	2	17	0.105	53	0	0	100	0	0	0	0	0	1	0	4
2	PC-637B	33	32	1	11	3	8	0.273	53	6	5	81	0	6	0	1	1	1	1	1
1	PC-638B	99	98	1	0	0	0	*****	0	0	0	0	0	0	0	0	0	0	0	1
2	PC-639B	25	23	2	19	4	15	0.211	54	0	2	97	0	0	1	0	0	1	0	1
6	PC-640R	17	12	5	3	0	3	0.000	78	2	19	79	0	0	0	0	0	1	0	1
2	PC-641B	19	17	2	31	5	26	0.161	41	0	0	100	0	0	0	0	0	0	0	9
2	PC-642B	23	21	2	25	3	22	0.120	48	0	18	67	3	2	3	0	7	1	0	3
2	PC-643B	24	23	1	12	5	7	0.417	58	2	22	74	0	2	0	0	0	0	1	5
2	PC-644B	34	30	4	18	9	9	0.500	37	1	3	79	0	17	0	0	0	3	0	8
2	PC-645B	34	26	8	10	2	8	0.200	54	1	1	81	0	15	2	0	0	0	1	1
2	PC-646B	11	7	4	1	1	0	1.000	87	0	38	59	2	0	0	1	0	0	0	1
2	PC-647B	14	5	9	1	0	1	0.000	81	0	57	42	0	0	1	0	0	3	0	0
2	PC-648B	16	8	8	1	0	1	0.000	80	3	19	71	2	1	4	0	0	2	0	1
1	PC-649B	99	96	3	0	0	0	*****	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
6	PC-650R	15	12	3	6	4	2	0.667	75	0	2	96	0	2	0	0	0	0	4	0
1	PC-651B	98	95	3	1	1	0	1.000	1	24	52	0	0	0	0	6	18	0	0	0
1	PC-652B	97	96	1	1	1	0	1.000	1	10	50	0	0	0	0	20	20	0	0	1
1	PC-653B	22	0	0	0	0	0	*****	0	0	0	0	0	0	0	0	0	0	0	78
1	PC-654B	56	55	1	3	1	2	0.333	36	0	0	1	1	98	0	0	0	1	1	3
1	PC-655B	88	86	2	5	4	1	0.800	6	0	78	0	20	0	1	0	1	0	0	1
6	PC-656R	95	93	2	2	2	0	1.000	1	NA	NA	NA	NA	NA	NA	NA	NA	0	1	1
2	PC-659B	35	29	6	26	4	22	0.154	35	6	47	30	3	9	0	3	2	0	1	3
1	PC-660B	85	73	12	9	5	4	0.556	5	7	80	0	10	0	0	2	1	0	0	1
1	PC-661B	94	93	1	1	0	1	0.000	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	4
1	PC-662B	93	91	2	3	2	1	0.667	2	0	73	0	21	0	0	0	6	1	0	1
1	PC-664B	96	94	2	3	2	1	0.667	1	NA	NA	NA	NA	NA	NA	NA	NA	1	0	0
2	PC-665B	30	26	4	19	4	15	0.211	41	0	99	0	0	0	0	0	1	1	0	9
1	PC-666B	80	80	0	20	15	5	0.750	0	0	0	0	0	100	0	0	0	0	0	2
2	PC-667D	28	21	7	22	6	16	0.273	46	1	99	0	0	0	0	0	0	1	0	3
1	PC-668B	84	80	4	8	7	1	0.875	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	7
1	PC-669B	97	88	9	2	1	1	0.500	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
1	PC-670B	96	92	4	3	2	1	0.667	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	1
1	PC-671B	84	81	3	2	1	1	0.500	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	13
1	PC-672B	99	93	6	1	0	1	0.000	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
1	PC-673B	95	92	3	3	3	0	1.000	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	1
1	PC-674B	96	94	2	3	2	1	0.667	0	NA	NA	NA	NA	NA	NA	NA	NA	0	1	0
1	PC-675B	94	90	4	4	3	1	0.750	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	1
1	PC-676B	88	85	3	0	0	0	*****	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	11
1	PC-677B	100	96	4	0	0	0	*****	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
1	PC-678B	99	95	4	0	0	0	*****	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	1
1	PC-679B	98	92	6	1	1	0	1.000	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
1	PC-680B	98	95	3	0	0	0	*****	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	2
1	PC-681B	98	90	8	0	0	0	*****	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	1
1	PC-682B	96	92	4	2	1	1	0.500	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	1
1	PC-683B	96	91	5	4	3	1	0.750	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
1	PC-684B	98	97	1	1	1	0	1.000	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	1
1	PC-685B	83	79	4	2	2	0	1.000	9	0	0	0	0	100	0	0	0	0	0	6

APPENDIX III PETROGRAPHIC DATA OF SOUTH AMERICAN BEACH AND RIVER SANDS

PROVINCE	SAMPLE	Qt	Qu	Qc	Ft	Fk	Fp	Fk/Ft	RFt	P	M	V	Ar	Ca	Sa	Si	A	C	M	HM
1	PC-686B	89	88	1	3	2	1	0.667	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	8
1	PC-687B	81	75	6	0	0	0	*****	19	0	1	0	0	99	0	0	0	0	0	0
1	PC-688B	80	71	9	0	0	0	*****	20	0	0	0	0	100	0	0	0	0	0	0
1	PC-689R	70	64	6	3	2	1	0.667	24	0	1	0	0	0	0	0	99	0	0	3
1	PC-690B	89	80	9	9	7	2	0.778	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	1
1	PC-691B	98	96	2	1	1	0	1.000	0	0	0	0	0	0	0	0	0	0	0	1
1	PC-692B	98	93	5	1	0	1	0.000	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
1	PC-694B	96	95	1	2	1	1	0.500	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	1
1	PC-695B	78	73	5	5	4	1	0.800	13	0	19	0	0	15	1	0	65	0	2	2
1	PC-696B	94	90	4	2	1	1	0.500	3	0	2	0	0	78	0	1	19	0	0	1
1	PC-697B	95	3	2	0	0	0	*****	2	NA	NA	NA	NA	NA	NA	NA	NA	0	0	3
1	PC-698B	74	68	6	3	2	1	0.667	19	0	20	0	0	13	1	0	66	0	1	3
1	PC-699B	99	97	2	1	1	0	1.000	0	0	0	0	0	0	0	0	0	0	0	0
5	PC-700B	60	15	45	6	1	5	0.167	33	0	46	0	0	51	0	0	0	0	0	1
1	PC-701B	15	11	4	4	3	1	0.750	19	2	8	0	0	90	0	0	0	0	0	62
1	PC-702B	9	9	0	7	5	2	0.714	14	0	10	1	0	68	0	0	1	0	1	69
3	PC-703B	4	4	0	10	1	9	0.100	61	14	0	58	0	28	0	0	0	1	0	24
1	PC-704B	69	50	19	20	8	12	0.400	10	78	22	0	0	0	0	0	0	1	0	0
1	PC-705B	43	28	15	38	34	4	0.895	17	8	25	6	1	45	9	6	0	1	0	1
1	PC-706B	79	70	9	15	8	7	0.533	4	29	69	0	0	0	0	0	2	1	0	1
1	PC-707B	21	16	5	7	6	1	0.857	69	2	23	0	0	75	0	0	0	0	0	3
1	PC-708B	84	79	5	9	5	4	0.556	7	0	0	0	0	100	0	0	0	0	0	0
1	PC-709B	84	82	2	1	1	0	1.000	13	0	0	0	0	98	0	0	2	1	0	1
1	PC-710B	91	90	1	5	4	1	0.800	2	40	20	0	0	0	0	0	40	0	1	1
1	PC-711B	90	88	2	2	2	0	1.000	7	6	0	0	87	0	0	0	7	0	0	1
1	PC-712B	81	80	1	1	0	1	0.000	17	0	0	0	0	100	0	0	0	0	1	0
1	PC-713B	86	84	2	0	0	0	*****	14	0	0	0	0	100	0	0	0	0	0	0
6	PC-714R	32	30	2	16	2	14	0.125	41	2	21	77	0	0	0	0	0	2	2	7
1	PC-715B	97	97	0	2	2	0	1.000	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
3	PC-718B	24	22	2	4	1	3	0.250	67	0	30	67	0	0	3	0	0	0	0	5
3	PC-719B	26	22	4	6	2	4	0.333	66	0	10	82	0	1	6	0	1	0	1	1
6	PC-720R	99	94	5	1	1	0	1.000	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
3	PC-721B	48	41	7	11	1	10	0.091	34	0	13	72	1	7	5	2	0	1	1	5
3	PC-722B	24	20	4	31	9	22	0.290	28	10	2	71	15	0	0	2	0	0	0	17
3	PC-723B	10	8	2	37	4	33	0.108	42	4	8	87	0	0	1	0	0	1	0	10
3	PC-724B	15	12	3	13	1	12	0.077	52	0	1	98	0	1	0	0	0	1	0	19
3	PC-725B	32	29	3	40	19	21	0.475	25	29	47	22	1	1	0	0	0	0	0	3
3	PC-726B	46	41	5	11	1	10	0.091	33	6	52	42	0	0	0	0	0	2	0	8
3	PC-727B	43	34	9	17	2	15	0.118	34	3	71	20	0	4	0	1	1	1	0	5
3	PC-728B	56	46	10	14	8	6	0.571	28	4	43	38	0	15	0	0	0	0	1	1
3	PC-729B	23	22	1	15	5	10	0.333	52	6	48	23	0	23	0	0	0	0	1	10
3	PC-730B	51	46	5	14	4	10	0.286	33	0	61	3	0	34	2	0	0	1	1	0
3	PC-731B	53	50	3	15	1	14	0.067	30	0	7	59	0	32	2	0	0	0	0	2
3	PC-732B	18	16	2	21	5	16	0.238	50	10	3	30	0	7	0	0	0	1	0	10
3	PC-733B	50	42	8	12	3	9	0.250	29	0	88	0	0	0	1	1	10	1	0	8
3	PC-734B	14	13	1	11	0	11	0.000	66	0	4	74	1	21	0	0	0	1	0	8
3	PC-735B	18	17	1	19	4	15	0.211	61	0	0	95	0	0	4	1	0	1	0	1
3	PC-736B	7	6	1	14	1	13	0.071	74	5	3	41	0	50	0	1	0	0	0	5

APPENDIX III PETROGRAPHIC DATA OF SOUTH AMERICAN BEACH AND RIVER SANDS

PROVINCE	SAMPLE	Qt	Qu	Qc	Ft	Fk	Fp	Fk/Ft	RFt	P	M	V	Ar	Ca	Sa	Si	A	C	M	HM
3	PC-737B	27	24	3	3	3	0	1.000	61	1	8	0	2	89	0	0	0	3	1	5
3	PC-738B	42	34	8	6	1	5	0.167	41	0	15	0	1	83	0	1	0	0	0	11
3	PC-739B	56	50	6	5	1	4	0.200	35	0	12	22	0	66	0	0	0	3	0	1
3	PC-740B	35	32	3	12	4	8	0.333	25	1	37	1	0	60	0	0	1	0	0	28
1	PC-741B	99	99	0	1	1	0	1.000	0	0	0	0	0	0	0	0	0	0	0	0
2	PC-743B	22	14	8	12	11	1	0.917	62	1	1	91	0	6	1	1	0	0	0	4
2	PC-744B	19	14	5	5	0	5	0.000	64	0	2	97	0	1	0	0	0	2	0	10
2	PC-745B	34	29	5	12	4	8	0.333	48	0	79	20	0	1	0	0	0	1	1	4
4	PC-747B	55	43	12	6	4	2	0.667	30	1	69	24	0	2	3	1	0	1	3	5
1	PC-748B	71	70	1	3	2	1	0.667	24	49	0	8	0	0	92	0	0	0	1	1
5	PC-749B	98	94	4	0	0	0	*****	1	0	83	0	0	0	0	0	17	0	0	1
1	PC-750B	94	80	14	4	4	0	1.000	2	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
6	PC-751R	99	97	2	0	0	0	*****	1	0	0	0	0	0	0	0	0	1	0	0
6	PC-752R	95	90	5	3	2	1	0.667	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	1
6	PC-753R	94	86	8	3	2	1	0.667	2	0	88	0	0	0	2	0	10	0	0	1
6	PC-754R	96	93	3	3	2	1	0.667	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
6	PC-755R	95	86	9	1	1	0	1.000	5	0	0	0	0	0	0	0	100	0	0	2
3	PC-756B	22	22	0	40	16	24	0.400	29	14	47	3	0	35	0	1	0	0	0	9
3	PC-757B	20	16	4	30	3	27	0.100	39	6	56	4	1	32	0	1	0	0	0	11
3	PC-758B	3	2	1	10	2	8	0.200	37	96	4	0	0	0	0	0	0	0	0	50
3	PC-759B	23	21	2	10	7	3	0.700	65	11	54	12	0	17	4	2	0	0	1	1
3	PC-760B	23	14	9	3	1	2	0.333	76	2	98	0	0	0	0	0	0	0	0	0
3	PC-761B	28	13	15	3	2	1	0.667	67	0	100	0	0	0	0	0	0	1	0	1
3	PC-762B	3	1	2	5	0	5	0.000	92	6	49	22	0	23	0	0	0	0	0	0
3	PC-763B	21	16	5	7	0	7	0.000	51	3	22	21	1	52	1	0	0	0	3	17
3	PC-764B	12	11	1	8	0	8	0.000	76	15	8	77	0	0	0	0	0	0	0	4
3	PC-765B	9	8	1	41	7	34	0.171	45	9	23	3	0	63	2	0	0	0	1	4
3	PC-766B	20	16	4	15	7	8	0.467	52	6	7	83	0	4	0	0	0	0	1	12
3	PC-767B	18	16	2	25	8	17	0.320	50	1	79	19	0	1	0	0	0	0	1	6
3	PC-768B	2	0	0	14	1	13	0.071	76	0	28	4	0	67	1	0	0	0	0	8
3	PC-769B	22	20	2	29	5	24	0.172	37	5	50	33	0	10	0	1	1	0	0	12
3	PC-770B	34	28	6	21	5	16	0.238	39	25	66	8	0	1	0	0	0	0	0	6
3	PC-771B	25	18	7	22	18	4	0.818	44	5	22	68	1	0	1	3	0	1	0	8
3	PC-772B	6	6	0	2	0	2	0.000	88	4	0	96	0	0	0	0	0	3	0	1
3	PC-773B	0	0	0	1	0	1	0.000	97	3	0	67	0	30	0	0	0	1	0	1
6	PC-774R	100	96	4	0	0	0	*****	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
3	PC-775B	4	4	0	7	0	7	0.000	72	0	2	98	0	0	0	0	0	0	1	16
3	PC-776B	3	2	1	7	2	5	0.286	43	1	1	98	0	0	0	0	0	0	0	47
3	PC-777B	6	6	0	7	0	7	0.000	78	2	0	98	0	0	0	0	0	0	0	9
3	PC-778B	3	2	1	26	2	24	0.077	60	0	0	100	0	0	0	0	0	0	0	23
3	PC-779B	10	10	0	11	2	9	0.182	78	1	0	99	0	0	0	0	0	0	0	1
3	PC-780B	5	4	1	10	2	8	0.200	68	3	6	91	0	0	0	0	0	0	0	17
3	PC-781B	5	3	2	12	1	11	0.083	71	3	1	96	0	0	0	0	0	1	0	11
3	PC-782B	2	2	0	2	0	2	0.000	92	0	0	100	0	0	0	0	0	0	0	4
3	PC-783B	0	0	0	8	2	6	0.250	48	2	0	98	0	0	0	0	0	0	0	44
3	PC-784B	30	26	4	13	3	10	0.231	46	0	1	97	0	1	1	0	0	0	1	10
3	PC-785B	10	8	2	12	2	10	0.167	73	2	0	98	0	0	0	0	0	1	0	4
6	PC-789R	0	0	0	7	1	6	0.143	87	3	0	97	0	0	0	0	0	0	0	6
6	PC-790R	21	19	2	18	8	10	0.444	58	5	5	80	0	9	0	1	0	0	1	2

APPENDIX III PETROGRAPHIC DATA OF SOUTH AMERICAN BEACH AND RIVER SANDS

PROVINCE	SAMPLE	Qt	Qu	Qc	Ft	Fk	Fp	Fk/Ft	RFt	P	M	V	Ar	Ca	Sa	Si	A	C	M	HM
6	PC-791R	0	0	0	2	0	2	0.000	96	15	5	76	0	4	0	0	0	0	0	2
6	PC-792R	1	1	0	4	0	4	0.000	90	7	12	68	0	8	0	3	2	0	0	5
6	PC-793R	12	11	1	11	4	7	0.364	71	10	8	81	0	1	0	0	0	0	1	5
6	PC-794R	11	10	1	16	3	13	0.188	68	8	57	35	0	0	0	0	0	0	0	5
3	PC-795B	8	6	2	4	1	3	0.250	85	15	11	4	0	70	0	0	0	1	0	2
6	PC-796R	14	11	3	14	2	12	0.143	65	8	40	45	3	0	2	2	0	0	3	4
6	PC-797R	29	26	3	13	0	13	0.000	45	0	4	91	0	2	3	0	0	0	0	13
6	PC-798R	6	6	0	9	2	7	0.222	63	20	11	61	1	4	1	1	1	0	1	21
6	PC-799R	14	12	2	16	2	14	0.125	58	2	98	0	0	0	0	0	0	0	2	10
6	PC-800R	16	16	0	22	5	17	0.227	55	12	7	77	0	2	0	2	0	0	2	5
6	PC-801R	14	11	3	26	1	25	0.038	53	9	6	66	0	17	1	1	0	0	1	7
6	PC-802R	41	35	6	4	0	4	0.000	52	1	3	90	0	1	4	1	0	0	1	2
2	PC-803B	26	16	10	12	5	7	0.417	56	1	3	95	0	1	0	0	0	1	0	5
2	PC-804B	24	17	7	8	3	5	0.375	64	0	8	90	0	2	0	0	0	1	0	3
3	PC-805B	9	7	2	10	4	6	0.400	61	3	0	97	0	0	0	0	0	1	1	18
3	PC-806B	4	3	1	14	7	7	0.500	73	2	25	10	0	63	0	0	0	0	0	9
3	PC-807B	31	29	2	16	1	15	0.063	39	1	19	44	0	36	0	0	0	1	0	13
3	PC-808B	4	3	1	17	1	16	0.059	8	2	44	41	7	5	1	0	0	0	0	71
5	PC-809B	80	60	20	13	9	4	0.692	3	0	21	0	0	4	0	0	0	0	0	4
5	PC-810B	62	57	5	2	1	1	0.500	23	0	0	0	1	96	0	1	2	0	0	13
5	PC-811B	68	54	14	5	4	1	0.800	21	0	1	0	2	97	0	1	0	0	0	6
5	PC-812B	55	46	9	7	4	3	0.571	37	0	3	3	0	89	3	2	0	1	0	0
6	PC-813R	28	24	4	1	0	1	0.000	65	0	2	89	0	6	0	2	1	1	1	4
5	PC-814B	95	79	16	2	2	0	1.000	2	10	57	0	5	35	3	0	0	1	0	0
6	PC-815R	78	61	17	2	1	1	0.500	18	0	60	0	1	13	16	5	5	0	1	1
5	PC-816B	93	78	15	1	1	0	1.000	4	0	13	0	2	9	17	3	56	1	0	1
6	PC-817R	1	1	0	8	1	7	0.125	84	0	0	100	0	0	0	0	0	0	0	7
5	PC-818B	100	95	5	0	0	0	*****	0	0	0	0	0	0	0	0	0	0	0	0
5	PC-819B	90	78	12	0	0	0	*****	8	0	0	0	64	20	8	1	7	1	0	1
5	PC-820B	89	71	18	2	1	1	0.500	5	0	2	0	7	6	3	1	81	0	0	4
6	PC-821R	80	53	27	0	0	0	*****	12	0	1	0	0	2	3	0	94	2	0	6
5	PC-822B	60	26	34	5	4	1	0.800	31	0	97	0	0	0	0	0	3	0	0	4
6	PC-823R	86	61	25	4	2	2	0.500	8	0	27	0	0	22	51	0	0	0	1	1
5	PC-824B	82	76	6	1	1	0	1.000	11	0	3	0	0	10	1	0	86	0	0	6
5	PC-825B	77	67	10	2	1	1	0.500	5	0	0	0	0	5	1	0	94	1	0	15
5	PC-826B	61	55	6	1	0	1	0.000	33	2	1	2	0	79	3	0	13	0	1	4
5	PC-827B	73	68	5	1	0	1	0.000	24	0	3	0	0	96	1	0	0	1	0	1
5	PC-828B	57	25	32	30	28	2	0.933	13	0	100	0	0	0	0	0	0	0	0	0
5	PC-829B	27	17	10	0	0	0	*****	71	0	86	0	0	9	4	0	1	0	0	2
5	PC-830B	95	88	7	1	1	0	1.000	2	0	10	0	19	13	9	9	42	1	0	1
5	PC-831B	75	40	35	2	0	2	0.000	20	0	13	0	1	81	2	0	3	1	0	2
6	PC-832R	42	8	34	2	0	2	0.000	50	0	99	0	0	0	0	0	1	0	6	0
5	PC-833B	97	84	13	0	0	0	*****	2	0	0	0	0	2	0	0	0	0	0	1
5	PC-834B	94	82	12	0	0	0	*****	6	0	0	0	0	86	0	0	14	0	0	0
5	PC-835B	81	73	8	10	7	3	0.700	8	0	26	0	0	0	16	0	58	1	0	0
5	PC-836B	31	19	12	25	18	7	0.720	31	0	94	0	0	0	1	0	5	0	2	11
6	PC-837R	9	9	0	13	2	11	0.154	66	0	0	100	0	0	0	0	0	0	1	11
6	PC-838R	8	6	2	24	0	24	0.000	64	26	18	56	0	0	0	0	0	0	1	3
6	PC-839R	0	0	0	12	0	12	0.000	71	1	0	99	0	0	0	0	0	0	2	15

APPENDIX III PETROGRAPHIC DATA OF SOUTH AMERICAN BEACH AND RIVER SANDS

PROVINCE	SAMPLE	Qt	Qu	Qc	Ft	Fk	Fp	Fk/Ft	RFt	P	M	V	Ar	Ca	Sa	Si	A	C	M	HM
6	PC-840R	2	1	1	12	0	12	0.000	72	0	0	100	0	0	0	0	0	0	0	14
6	PC-841R	49	46	3	6	5	1	0.833	16	8	24	65	0	0	3	0	0	0	0	29
6	PC-842R	11	11	0	11	5	6	0.455	70	7	7	86	0	0	0	0	0	0	1	7
6	PC-843R	12	10	2	15	4	11	0.267	58	5	85	7	0	3	0	0	0	0	1	14
6	PC-844R	2	1	1	10	1	9	0.100	81	0	1	99	0	0	0	0	0	0	1	6
5	PC-845B	81	74	7	3	2	1	0.667	12	0	16	0	16	28	0	18	22	1	0	3
3	PC-846B	17	16	1	35	0	35	0.000	26	0	20	79	0	1	0	0	0	0	1	21
3	PC-847B	25	24	1	18	0	18	0.000	47	0	15	46	0	38	0	0	1	1	0	9
6	PC-848R	84	78	6	10	9	1	0.900	2	6	88	0	0	0	6	0	0	0	1	3
1	PC-849B	8	8	0	2	0	2	0.000	87	0	0	88	0	12	0	0	0	0	0	3
1	PC-850B	56	54	2	16	2	14	0.125	15	0	77	0	0	22	1	0	0	0	0	13
1	PC-851B	99	95	4	1	0	1	0.000	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
1	PC-852B	6	6	0	0	0	0	*****	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	94
1	PC-853B	99	95	4	0	0	0	*****	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
6	PC-854R	53	45	8	9	3	6	0.333	27	0	100	0	0	0	0	0	0	1	1	9
6	PC-855R	19	17	2	34	11	23	0.324	34	0	99	1	0	0	0	0	0	0	2	11
6	PC-856R	14	8	6	18	2	16	0.111	53	4	7	86	0	0	2	1	1	1	3	11
6	PC-857R	26	22	4	22	7	15	0.318	44	3	77	18	0	0	1	1	0	1	1	8
3	PC-858B	22	16	6	15	12	3	0.800	56	1	2	2	0	93	2	0	0	0	0	7
3	PC-859B	1	0	1	1	0	1	0.000	96	0	19	20	2	0	0	0	0	1	0	1
7	PC-860B	96	87	9	0	0	0	*****	4	0	0	0	0	0	0	0	0	0	0	0
7	PC-861B	100	91	9	0	0	0	*****	0	0	0	0	0	0	0	0	0	0	0	0
7	PC-862B	99	94	5	0	0	0	*****	0	0	0	0	0	0	0	0	0	0	0	1
7	PC-863B	100	97	3	0	0	0	*****	0	0	0	0	0	0	0	0	0	0	0	0
7	PC-864B	99	95	4	1	1	0	1.000	0	0	0	0	0	0	0	0	0	0	0	0
7	PC-865B	95	93	2	2	2	0	1.000	1	0	0	0	0	0	0	0	0	0	0	2
7	PC-866B	49	46	3	3	0	3	0.000	0	0	0	0	0	0	0	0	0	1	0	47
7	PC-867B	65	65	0	2	1	1	0.500	4	0	0	0	0	100	0	0	0	0	0	29
7	PC-868B	17	13	4	15	4	11	0.267	65	NA	NA	NA	NA	4	NA	NA	NA	0	0	3
7	PC-869B	14	11	3	17	16	1	0.941	67	13	1	82	0	2	1	1	0	0	0	2
7	PC-870B	19	19	0	18	2	16	0.111	63	7	2	83	0	8	0	0	0	0	0	0
7	PC-871B	23	20	3	13	1	12	0.077	61	0	14	67	1	17	1	0	0	0	0	3
7	PC-872B	16	14	2	15	0	15	0.000	60	3	12	70	0	15	0	0	0	0	0	9
7	PC-873B	14	13	1	9	0	9	0.000	42	0	25	52	1	22	0	0	0	0	3	32
7	PC-874B	1	1	0	2	0	2	0.000	6	0	36	0	6	58	0	0	0	0	0	9
7	PC-875B	1	1	0	1	1	0	1.000	2	NA	NA	NA	NA	NA	NA	NA	NA	0	0	98
6	PC-876R	99	97	2	1	1	0	1.000	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
7	PC-877B	24	17	7	9	0	9	0.000	54	0	87	13	0	0	0	0	0	0	1	12
3	PC-878B	11	11	0	6	0	6	0.000	57	0	80	19	0	1	0	0	0	0	0	25
7	PC-879B	15	8	7	14	0	14	0.000	55	0	84	16	0	0	0	0	0	0	1	15
6	PC-880R	15	9	6	23	4	19	0.174	55	0	82	10	0	5	0	0	2	0	0	7
6	PC-881R	8	3	5	2	0	2	0.000	78	NA	NA	NA	NA	NA	NA	NA	NA	0	0	12
6	PC-882R	10	7	3	0	0	0	*****	90	0	2	0	92	0	4	2	0	0	0	0
6	PC-883R	29	24	5	0	0	0	*****	67	0	77	0	23	0	0	0	0	0	1	3
6	PC-884R	98	96	2	0	0	0	*****	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	1
1	PC-885B	100	98	2	0	0	0	*****	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
1	PC-886B	91	87	4	4	3	1	0.750	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	4
6	PC-887R	97	82	15	0	0	0	*****	1	NA	NA	NA	NA	NA	NA	NA	NA	0	0	2
7	PC-888B	0	0	0	0	0	0	*****	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	100

APPENDIX III PETROGRAPHIC DATA OF SOUTH AMERICAN BEACH AND RIVER SANDS

PROVINCE	SAMPLE	Qt	Qu	Qc	Ft	Fk	Fp	Fk/Ft	RFt	P	M	V	Ar	Ca	Sa	Si	A	C	M	HM
5	PC-889B	22	18	4	0	0	0	*****	75	0	0	1	2	95	0	0	2	0	0	3
4	PC-890B	9	8	1	2	2	0	1.000	1	NA	NA	NA	NA	NA	NA	NA	NA	0	1	87
5	PC-891B	42	41	1	1	1	0	1.000	51	0	3	0	0	96	1	0	0	0	0	6
4	PC-892B	43	38	5	8	5	3	0.625	29	0	92	6	1	0	0	0	0	0	0	20
5	PC-893B	21	16	5	1	0	1	0.000	76	0	10	0	0	89	0	0	1	0	0	2
3	PC-894B	14	11	3	5	0	5	0.000	53	0	92	7	0	0	0	0	1	0	3	25
3	PC-895B	14	10	4	4	0	4	0.000	68	6	80	13	0	0	0	0	1	2	1	11
3	PC-896B	15	9	6	20	2	18	0.100	59	0	75	25	0	0	0	0	0	0	0	6
6	PC-897R	28	25	3	25	10	15	0.400	29	0	79	16	2	0	0	0	0	0	1	17
6	PC-898R	29	18	11	10	0	10	0.000	53	0	95	3	0	0	0	0	2	0	3	5
5	PC-899B	53	50	3	11	7	4	0.636	35	3	11	9	0	79	0	0	0	0	0	1
5	PC-900B	66	61	5	11	9	2	0.818	21	1	17	4	3	75	0	0	0	0	0	2
6	PC-901R	47	40	7	26	13	13	0.500	27	13	68	4	0	15	0	0	0	0	0	0
6	PC-902R	35	26	9	36	19	17	0.528	27	84	16	0	0	0	0	0	0	0	0	2
6	PC-903R	52	43	9	24	12	12	0.500	21	66	33	0	0	0	0	0	1	0	2	1
6	PC-904R	5	4	1	46	3	43	0.065	15	3	97	0	0	0	0	0	0	0	1	33
6	PC-905R	26	25	1	48	15	33	0.313	16	82	10	0	0	0	0	0	8	0	4	6
6	PC-906R	15	13	2	33	9	24	0.273	20	33	65	0	0	0	0	0	0	0	11	21
6	PC-907R	30	25	5	32	3	29	0.094	14	79	19	0	0	0	0	0	2	0	6	18
5	PC-908B	26	22	4	28	1	27	0.036	38	80	19	1	0	0	0	0	0	0	2	6
5	PC-909B	28	22	6	18	0	18	0.000	11	5	92	0	0	0	3	0	0	0	1	42
4	PC-910B	15	11	4	15	2	13	0.133	10	61	34	0	0	5	0	0	0	1	1	58
4	PC-911B	44	24	20	10	7	3	0.700	45	0	25	3	1	70	0	0	1	0	0	1
4	PC-912B	45	39	6	14	4	10	0.286	37	0	48	7	32	12	1	0	0	0	0	8
5	PC-913B	37	31	6	26	3	23	0.115	19	65	31	1	0	3	0	0	0	0	1	17
5	PC-914B	46	32	14	26	0	26	0.000	13	29	62	2	2	2	0	1	2	0	2	13
6	PC-915R	94	92	2	2	1	1	0.500	3	0	0	0	0	97	0	0	3	0	0	1
4	PC-916B	44	37	7	13	0	13	0.000	21	1	93	1	1	1	1	1	1	1	0	21
4	PC-917B	53	44	9	17	5	12	0.294	17	1	89	3	1	5	0	0	1	0	0	13
6	PC-918R	5	5	0	1	0	1	0.000	94	0	1	0	83	2	7	7	0	0	0	0
1	PC-919B	95	91	4	2	1	1	0.500	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	3
1	PC-920B	18	15	3	37	16	21	0.432	44	83	15	0	0	0	2	0	0	0	0	1
1	PC-921B	93	91	2	2	1	1	0.500	4	NA	NA	NA	NA	NA	NA	NA	NA	0	0	1
1	PC-922B	97	96	1	0	0	0	*****	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	3
5	PC-925B	5	5	0	0	0	0	*****	95	0	0	0	0	100	0	0	0	0	0	0
7	PC-939FA	82	74	8	1	1	0	1.000	6	0	83	0	0	0	6	2	3	0	0	11
7	PC-940FA	63	59	4	2	0	2	0.000	15	0	97	0	0	0	2	1	0	1	0	19
1	PC-949	94	92	2	3	3	0	1.000	2	NA	NA	NA	NA	NA	NA	NA	NA	0	0	1
1	PC-950B	85	85	0	1	1	0	1.000	12	0	1	0	26	74	0	0	0	0	0	2
1	PC-951B	95	90	5	3	3	0	1.000	2	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0
1	PC-952B	85	83	2	1	1	0	1.000	13	0	0	0	1	25	0	0	0	0	0	1
1	PC-953B	87	86	1	2	2	0	1.000	8	0	0	0	0	17	0	0	0	0	0	3
1	PC-954B	33	17	16	10	0	10	0.000	13	0	48	1	0	45	0	0	6	0	0	44
3	PC-962B	6	4	2	0	0	0	*****	17	NA	NA	NA	NA	NA	NA	NA	NA	0	0	77
3	PC-963B	31	18	13	4	0	8	0.000	57	NA	NA	NA	NA	NA	NA	NA	NA	0	0	8
3	PC-964B	49	37	12	3	1	2	0.333	42	NA	NA	NA	NA	NA	NA	NA	NA	0	0	5
3	PC-965B	42	36	6	3	2	1	0.667	30	NA	NA	NA	NA	NA	NA	NA	NA	1	2	22
3	PC-966R	14	9	5	2	1	1	0.500	72	NA	NA	NA	NA	NA	NA	NA	NA	11	0	1